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F10 PRODUCTS

F10, A NOVEL PRODUCT RANGE MOST SUITED TO ZOOLOGICAL MEDICINE

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INTRODUCTION

The core actives of the F10 Veterinary Disinfectant product range are quaternary ammonium and biguanidine compounds which act synergistically to kill a wide range of viruses, bacteria, fungi and spores. It is available as a concentrated disinfectant for dilution with water (F10SC Veterinary Disinfectant), a combined disinfectant and cleanser (F10SCXD Disinfectant/Cleanser), a germicidal treatment shampoo (F10 Germicidal Treatment Shampoo), a germicidal barrier ointment (F10 Germicidal Barrier Ointment) with or without cypermethrin as an insecticide and as a new wound spray which also contains cypermethrin (F10 Germicidal Wound Spray with Insecticide). The F10 product range is manufactured by Health and Hygiene (Pty) Ltd in South Africa. These products have been used on a wide variety of vertebrates, including mammals, birds, reptiles and amphibians and show efficacy at low concentrations, with short contact times and with minimal tissue irritation.

Zoological medicine is characterized by the large variety of animal species that may be dealt with on a regular basis and products effective against a wide variety of pathogens and with low toxicity across taxa are useful and cost-effective additions to the zoo veterinarian's armoury. This paper discusses a range of applications for the F10 products which the author has found useful in clinical zoo practice.

NEBULISATION

Nebulisation involves the aerosolisation of a liquid therapeutic agent so as to allow its direct application into the upper and/or lower respiratory tract. It allows instantaneous drug delivery to the required site without the potential lag time which many systemic drugs take to achieve therapeutic tissue concentrations. It also allows drugs with systemic side effects such as aminoglycosides to be given safely, since the respiratory epithelium is relatively impermeable and it is also a good method of rehydrating small animals, especially birds. Nebulisation is a particularly useful adjunct treatment in cases of fungal or bacterial upper and lower respiratory disease including rhinitis, sinusitis, tracheitis, bronchitis, air sacculitis and pneumonia. In avian species if air sac or lung disease is present, an ultrasonic nebuliser capable of producing a particle size of less than 5µm is preferable, since the diameter of the air capillaries ranges from 3-10µm. If upper respiratory tract disease is present, cheaper compressor nebulisers can be used, which produce a larger particle size. Typically animals are nebulised for 15-20 minutes two to three times a day with F10SC diluted 1:250 with saline. This has been found to be an effective adjunct therapy in many cases of rhinitis and sinusitis in birds, reptiles and small mammals, respiratory aspergillosis in birds, bacterial and fungal air sacculitis and acute pneumonia, including aspiration pneumonia in neonatal mammals.

Figure 1. Hand-reared tree squirrel with aspiration pneumonia. Treated successfully with daily F10 nebulisation and systemic antibiotics

FLUSHING

The nasal flush is a useful technique for management of upper respiratory tract infections in avian and reptilian patients (Chitty J 2002; Chitty J, 2004). The animal is restrained with its head downwards to avoid aspiration and F10SC, again at a concentration of 1:250 in saline is forcibly syringed into the external nares so that it exits through the choana and drains out of the oral cavity. Although the anatomy varies with species, this usually allows the flushing solution to pass over the surface of the nasal conchae and parts of the infraorbital sinus such as the preorbital diverticulum. This technique can be carried out easily and safely in most small to medium sized birds as well as lizards and chelonians and allows daily removal of accumulated mucus and inflammatory material as well as direct application of the medication to mucous membranes.

F10SC is also suitable for sinus flushing directly into the preorbital diverticulum in birds. Again the head is held below the body to avoid aspiration and the needle is inserted

Figure 2. Blue tongue skink with bacterial rhinitis. Treated with daily F10 nebulisation and nasal flushing as well as systemic ceftazidime

FACTS IN THIS ISSUE

perpendicularly through the skin at the commisure of the beak, under the zygomatic bone. The flushing solution should exit via the choana. Care must be taken to avoid the globe.

Figure 3.
Purulent rhinitis in a Leopard tortoise. Rhinitis in chelonia may have a viral, bacterial or mycoplasmal aetiology. In this case the underlying cause was a nasal foreign body - a piece of grass. Once removed the rhinitis cleared up with regular nasal flushing using F10 under propofol anaesthesia.

FOGGING

F10SC diluted at 1:250 with saline can also be used for fogging entire rooms as part of routine biosecurity measures. In the author's institution it is used for hospital wards, brooder room incubation and chick rearing facilities and quarantine units, particularly where groups of birds are housed together. Fogging with F10 may be done in the presence of the animals, since it is safe and non-irritant if inhaled either by them or by hospital staff.

WOUND MANAGEMENT

Trauma is one of the most common health problems seen in almost all zoo animals. Inter or intra-specific trauma may result from competition for space/territory, food, shelter or nesting sites and materials. It may be precipitated by abnormal behaviour for example in socially inept hand-reared individuals, animals suffering from concurrent disease or in birds unable to fly due to wing-clipping or pinioning. Self trauma is also common, either for behavioural reasons or due to animals injuring themselves on fences, the glass sides of vivaria or other inanimate objects in their environment.

Bite or claw wounds, horn injuries, blunt trauma, lacerations, abrasions, punctures and chronic wounds such as pododermatitis due to inappropriate husbandry or underlying disease are all common. While the principles are the same as in domestic species, wound management can prove challenging to deal with in zoo animals, especially in species that are not easily handled or observed. Primary or immediate closure is often only feasible for surgical wounds or sharp lacerations that are presented at a very early stage and many zoo mammals for example primates are adept at removing even buried sutures unless precautions are taken to prevent this. Delayed primary closure before granulation tissue appears and secondary closure when granulation tissue is already present can be useful but usually involve prior repeated debridement and lavage. Second intention healing where an open wound heals by granulation tissue formation, epithelialisation and contraction is the most commonly used method of dealing with minor and moderate wounds in zoo species.

The most common reason for choosing to allow wounds to heal by second intention is contamination of the wound, the degree of which is directly correlated to the time since injury and is also related to environmental factors such as enclosure substrate and hygiene. Bite wounds where the skin has been punctured and underlying tissues damaged are always heavily contaminated. Late presentation of wounds is much more common than in domestic species as many zoo species cannot easily be observed at close range and actively mask signs of illness or injury as a predation avoidance mechanism. Closure of a wound that has not been adequately cleaned or debrided predisposes the site to abscess formation and may be counterproductive (Myers, 2006). Since dead space increases the risk of infection, if this cannot be easily eliminated eg by drainage or sutures then wounds in this category should also be left open. Soft tissue loss or lack of available skin may also prevent primary closure. Examination, diagnosis and treatment may involve anaesthetising the animal first and the risk of multiple anaesthetics needed for repeated debridement for example may outweigh the benefits of primary closure. Difficulty in returning an animal safely to its social group after surgery is another common reason for electing minimally invasive second intention healing as a method of wound management.

Figure 4.
Blue duiker with fractured horn. After removal of the broken horn, cleaning, debridement and haemostasis, F10 Germicidal Barrier Ointment with Insecticide was applied to the area.

Figure 5.
Bushbuck with chronic superficial skin wound not healing due to constant fly worry. Healed after one application of F10 Germicidal Barrier Ointment with Insecticide and a single long acting penicillin injection.

Superficial first degree burns and some second degree burns heal well by second intention and traumatic wounds with compromised perfusion and ongoing tissue necrosis are also more successfully managed at least initially as open wounds. Disadvantages to second intention healing include the increased likelihood of fly strike or myiasis, exposure of important underlying structures and problems associated with contraction and epithelialisation for example the production of a fragile epithelialised surface which is continually retraumatised.

Initial wound management after restraint, assessment and stabilization of the patient usually involves debridement and wound lavage. Choice of irrigation solution depends on factors such as availability, tissue toxicity

Figure 6.
Leopard tortoise with carapacial fractures. After surgical repair of the fractures F10 Germicidal Wound Spray with Insecticide was applied every 3 days for 2 weeks after which the area was covered with polymethylmethacrylate.

and detrimental effects on wound healing. Povidone iodine, chlorhexidine, saline and lactated Ringers solution are all commonly used. F10SC at a dilution of 1:250 in saline provides a useful alternative which is non-irritant, non-toxic, has a broad spectrum of antimicrobial activity and retains this in the presence of moderate organic material. It can also be used for irrigation of larger body cavities such as the crop in cases of impaction or yeast infection, uterine lavage in cases of metritis and the abdominal cavity in cases of peritonitis in mammals.

Wounds that are to be allowed to heal by second intention may then be managed by the application of topical medications with or without dressings and bandages to provide an optimal wound healing environment and prevent further secondary infection (Liptak, 1997; Krahwinkel & Boothe, 2006). Again various topical products are commonly used including triple antibiotic ointments and silver sulfadiazine cream (Swaim, 1990). F10 Germicicdal Barrier Ointment,

Figure 7.
White rhino with minor facial wounds/abrasions due to fly worry. Pre and post treatment with F10 Germicidal Wound Spray with Insecticide.

Figure 8.
Polar bear after surgical removal of benign dermoid cysts. F10 Germicidal Wound Spray with Insecticide applied daily to the suture line.

based on quaternary ammonium and biguanidine compounds with glycerin and lanolin has been used by the author in many classes of vertebrate with no adverse side effects, even in amphibia where systemic absorption of topical medications is a particular concern. It has no apparent negative effects on epithelialisation or wound contraction and is also available with cypermethrin as an insecticide. This latter formulation is not recommended in amphibians or felids. It has also been applied by the author around external fixator pins after fracture repair in both birds and mammals.

Abscesses in reptiles and birds often consist of encapsulated caseous material that can be removed in one discrete piece, leaving a cavity which should be liberally lavaged with an appropriate antimicrobial agent such as F10SC diluted as stated above. After flushing, the abscess cavity is packed with F10 Germicidal Barrier Ointment and left to heal by secondary intention.

Severe pododermatitis in birds often necessitates surgical debridement of the lesion which may then be managed as an open wound (Burke et al, 2002). F10 Barrier Ointment may be used topically on the defect, in conjunction with appropriate systemic antibiotics until healing occurs.

An F10 Germicidal Wound Spray with Insecticide is also available which is useful for applying from a short distance to animals that cannot be easily restrained for more proactive wound care. It has a duration of activity of several days but is water soluble and so may need to be applied more frequently under certain weather conditions or in semi-aquatic species. If primary closure is used in zoo species, then often wounds are closed with absorbable sutures to avoid the need to anaesthetize an animal subsequently for suture removal. Since sutures can act as a nidus for infection and tracking of bacteria into a wound, this increases the likelihood of post surgical infection and an antimicrobial spray applied to the suture line can reduce this risk. This author also routinely applies F10 Germicial Wound Spray with Insecticide to hoofstock and other large mammals that have been anaesthetized with remote injection techniques since the darting procedure itself can result in infection at the dart site due to drawing of hair and skin into the wound and discharge or bleeding from the wound can increase the possibility of myiasis. The bright pink colouration of the wound spray is useful to mark the site of the dart wound, especially if dangerous opioids such as etorphine have been used, however the product is also available in a colourless formulation. As with the insecticidal barrier ointment, the

Figure 9.
Capybara with several bite wounds to skin and muscle of thorax and thick purulent diacharge. After surgical debridement and packing with F10 Germicidal Barrier Ointment the resulting tract was treated with daily flushing with F10 and 7 days' systemic antibiotics.

Figure 10.
Four weeks post presentation. Wounds healed and infection resolved

Figure 11.
Sitatunga immobilized with etorphine and azaperone. F10 Germicidal Wound Spray with Insecticide applied to dart site before reversal.

wound spray is also contraindicated in felids due to the cypermethrin component, although it has been used by the author with no ill effects on large cats including lions, tigers and a snow leopard with fly strike.

Figure 12. Guttoral toad with rostral abrasion. Treated with application of F10 Germicidal Barrier Ointment every second day.

Figure 13. Bactrian camel with mandibular abscess post surgical debridement. Treated with daily flushing with F10, application of F10 Germicidal Wound Spray with Insecticide and 12 days systemic ceftiofur.

DERMATOMYCOSES

F10 Treatment Shampoo has been used to treat fungal tail alopecia in an 8 year old red panda where culture isolated *Microsporum gypseum*. The tail was treated topically for two months, initially at intervals of 2-3 days and then at weekly intervals. No systemic treatment was given and after two months the hair had regrown and fungal culture was negative.

F10SC diluted 1:3000 with RO water is also used as a prophylactic treatment for amphibians during their quarantine period. Wild caught amphibians in particular are prone to secondary bacterial and fungal skin infections, particularly when undergoing the stress of adjusting to a life in captivity. Bathing of new frogs and toads once weekly for 5 minutes at the above dilution is carried out with the aim of reducing this risk. F10 at the above dilution has recently been shown to be 100% effective in killing

Figure 14. Painted Reed Frog being bathed in a 1:3000 dilution of F10SC for 5 minutes daily for 8 weeks.

Batrachochytrium dendrobatis zoosporangia *in vitro* and is therefore a potential therapeutic agent for amphibians infected with this important pathogen (Webb et al, 2007).

HOSPITAL HYGIENE

Finally F10 products are routinely used at the author's zoo hospital for disinfection and sterilisation purposes. Surfaces are disinfected with F10SC diluted 1:250 in water. If resistant viral contamination is suspected however, for example after housing a parrot positive for psittacine beak and feather disease, the concentration is increased to 1:125. This higher concentration is also used for footbaths placed at the entrance to quarantine units. Where development of a biofilm is likely such as in the post mortem room and hospital cages, F919 SC Degreaser/cleanser (a sodium and silicate compound) is used at a dilution of 1:50 with hot water.

Endotracheal tubes, feeding/crop tubes, and bottles for feeding neonates are washed in a 1:250 dilution of F10SCXD then rinsed with water before submersing them in a 1:250 dilution of F10SC. For cold sterilization of endoscopes and surgical instruments the concentration is increased to a 1:100 of F10SC.

Health and Hygiene have developed a comprehensive set of advisory guidelines covering the use of the F10 and F919 products in veterinary hospitals which are available on their internet web site www.healthandhygiene.net.

CONCLUSION

In conclusion, use of the various F10 products mentioned above has proven safe, effective and non-toxic to a variety of species even when inhaled or applied directly to open wounds. The author has used these products with success in amphibians, reptiles, birds and the following groups of mammals: insectivores, procyonidae, primates, edentates, rodents, felids, rhinos, hippos, equids, bears, camelids and bovids.

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