Case study: Wound management of a Florida box turtle (*Terrapene carolina bauri*)

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Abstract

A male Florida box turtle (Terrapene carolina bauri) under captive care in an outdoor enclosure was admitted to the veterinary hospital due to a necrotic wound on the right hind limb. The wound was debrided; pain relief and antibiotic injection were then administered. It remained in the hospital for approximately one month for treatment and was returned to the original enclosure when the wound was almost completely healed. It was re-admitted to the hospital after one week due to a new bite wound on the same site. The turtle then remained in the hospital cage for more than a month with the same wound management technique and procedures until full recovery.

Keywords: wound management, Florida box turtle, hydrogel, chlorhexidine, silver sulfadiazine, *Terrapene carolina bauri*, confiscation, necrotic wound, local anaesthesia

Introduction

In August 2015, a consignment of 61 Florida box turtle (*Terrapene carolina bauri)* was seized by the Authorities at the Hong Kong International Airport. They had been smuggled from the USA to Hong Kong (HK) destined for the illegal pet trade. The turtles were passed to the Wild Animal Rescue Centre at Kadoorie Farm & Botanic Garden (KFBG) for temporary holding on behalf of the HKSAR Government. The injured male Florida box turtle belonged to this seized group. This species has not been assessed for the IUCN Red List (International Union for Conservation of Nature and Natural Resources, 2017) but is listed on CITES appendix II (Convention on International Trade in Endangered Species of Wild Fauna and Flora, 2017). The turtles were transferred from a government animal holding facility to KFBG in September 2015. For large confiscations of turtles destined for the illegal pet trade, HK is often the transit point for the consignment that may eventually enter provinces in southern China or be shipped to other countries in Southeast Asia. KFBG has played an important role in taking care of seized wildlife and assisting the authorities in repatriating species or transferring them into international conservational or educational programs.

The male Florida box turtle was discovered with the leg injury in its outdoor enclosure and was admitted to the veterinary hospital for health check and medical treatment. It remained in the hospital for nearly three months. As few case studies concerning wound management of turtles are available online, this case provides a useful reference.

Methods

Husbandry considerations for the turtle

The preferred body temperature (PBT) of the Florida box turtle is 29-38°C (Niedzielski 2002). A digital thermometer, heat lamp, shelter and shallow water tray were provided in the hospital cage. Astroturf was used as a substrate. Daily rehydration for the turtle was done by soaking it in warm

water (within the PBT) for 30 mins. The turtle was fed an omnivorous diet (insects, mixed fruit and meat) daily and weighed once a week.

Wound management techniques for the turtle

The necrotic wound found on the right hind limb was debrided under local anaesthesia the day after admittance. The turtle remained in one of the hospital holding cages for treatment and observation for approximately a month. Lignocaine at 5 mg/kg diluted 1:1 with water for injection was injected ventrally into the semitendinosus muscle and perilesionally. The veterinarian directed the injection around the sciatic nerve and the branches of the nerve (peroneal and tibial nerves). Almost all sensitivity was lost within 10 minutes and the veterinarian debrided the wound without the limb retracting. Pain relief (tramadol at 10 mg/kg) and an antibiotic (ceftazidime at 20 mg/kg) were injected I/M every three days and for 5 doses (Carpenter, 2013) at the early stage of wound management.

During this early stage (first 10 days), the wound was disinfected with chlorhexidine scrub 0.05% and silver sulfadiazine 1% cream was used to eliminate the growth of micro-organisms. After the early stage, chlorhexidine scrub 0.05% was used continuously and hydrogel replaced the silver sulfadiazine to keep the wound bed moist. Wound treatment was as follows:

1. Chlorhexidine scrub 0.05% non-woven swab to disinfect the wound, minimum 5 minutes contact time (O'Dwyer, 2016).
2. Sterile 0.9% NaCl to rinse the disinfected wound until no bubbles remain.
3. Dry non-woven swab to absorb the extra 0.9% NaCl on the wound.
4. Apply silver sulfadiazine 1% cream/hydrogel to the wound.
5. Wound size was measured every 3-5 days by a calliper (mm).

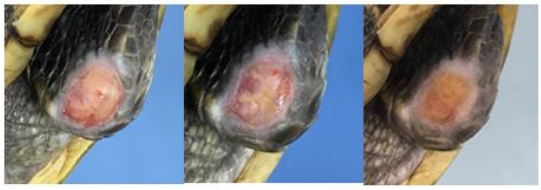
Results

At day 32, the turtle was re-examined by the veterinarian, the wound was not completely covered by new regenerating tissue but a scab had formed protecting the wound, so it was returned to its original enclosure. The wound size reduced from 12x13 mm to 5x7 mm (see Table 1 and Figure 1). After a week, it was returned to the veterinary hospital as the wound had re-opened; it was suspected to have been bitten by a cage-mate. The turtle remained in the hospital cage for more than a month following the same wound management techniques. At day 42 of the second hospitalization, the wound had totally healed from the original 6x7 mm wound and the turtle was returned to the original enclosure (see Table 2 and Figure 2).

Day	Size of wound (mm)
1	12 x 13
13	11 x 12
15	8.5 x 9.5
18	7.5 x 9
22	7 x 8
32	5 x 7

Table 1 Wound healing progress of first hospitalization

Day 1 Day 13 Day 15



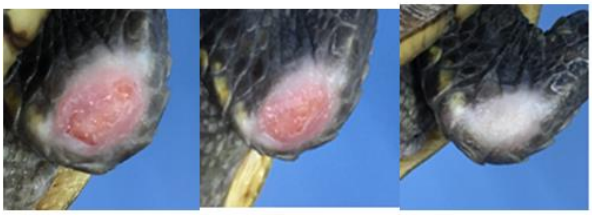
Day 18 Day 22 Day 32

Figure 1 Wound healing progress of first hospitalization

Day	Size of wound (mm)
1	6 x 7
7	6 x 7
11	6 x 9
15	5.5 x 8
21	4 x 6
26	2.5 x 5
42	0 x 0

Table 2 Wound healing progress of second hospitalization

Day 1 Day 7 Day 11 Day 15



Day 21 Day 26 Day 42

Figure 2 Wound healing progress of second hospitalization

Discussion

Wound healing is affected by physical factors (e.g. temperature, moisture and oxygenation of the wound bed), endogenous factors (e.g. nourishment of the wound bed) and exogenous factors (e.g. cleanliness of the surrounding environment and contact of external chemicals) (Winkler 2018). As reptiles are ectothermic, wound healing is highly dependent on the ambient temperature (Smith et al, 1988). Hydrogel was applied to the wound to provide a moist environment for the new cells to migrate and proliferate. Cage temperature was kept within the PBT to increase blood flow to the wound and hence increase oxygenation of the wound bed. The turtle was provided an omnivorous diet daily to provide maximum nutrition during recovery. The treatment cage was simple to avoid wound contamination. 1% silver sulfadiazine and 0.05% chlorhexidine gluconate were applied to the turtle.

0.05% chlorhexidine solution is well-known for wound disinfection; this concentration is antiseptic but does not damage delicate regenerating tissue on the wound bed (Vella, 2004). Chlorhexidine solutions at higher concentrations kills fibroblasts which are essential for wound healing (O'Dwyer 2016). 4% chlorhexidine was added to the water at a ratio of 1:79. The colour of the final solution was not a reliable indicator of concentration as different brands of chlorhexidine vary in the intensity of pink colour, appropriate dilution was undertaken to avoid chlorhexidine toxicity to the wound bed.

There is a distinct inhibition of wound healing by 0.05% chlorhexidine solution, compared to tap water and normal saline (Salami et al, 2006). The chlorhexidine disrupts fibroblast migration and proliferation. Although chlorhexidine is useful in disinfecting intact skin and cleaning dirty traumatic wounds, these agents should not be used to clean healing wounds (Salami et al, 2006). The results of this case can be used to improve wound management in future similar cases: chlorhexidine solution can be used in the early stage when the wound is still contaminated and normal saline can be used in the middle and end stages of treatment when the wound is no longer infected. Such treatment should shorten wound healing time.

Conclusions

"The understanding of wound healing in reptiles is still in its infancy and, to date, many of the therapeutic methods used in reptiles have been adopted from those in use in human, mammalian or avian species" (Cousquer, 2007). Basic factors that affect the wound healing are key to successful wound management. Trials using different combinations of wound management techniques may provide appropriate strategies for wildlife and exotic animal rehabilitators to manage wounds successfully.

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