AFRICAN NILE CROCODILE BITE OF THE FOREARM: A CASE REPORT

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ABSTRACT

African Nile crocodiles are the only species of crocodile consistently found across central and sub-Saharan Africa. A large and specifically aggressive species of the African Nile crocodile is solely responsible for almost all unprovoked attacks on humans, the exact incidence of which is unknown. The reported mortality rate of an African Nile crocodile attack is between 65-91% with up to 70% of surviving individuals with a bite of a limb ultimately requiring amputation.

We describe an adult male patient whom, during the course of performing his daily duties, slipped on a riverbank and fell into the water where he was immediately seized on the left forearm by an African Nile crocodile. Through fighting back the African Nile crocodile released its hold and he was able to survive the attack and reach our unit. Despite relatively benign looking wounds the initial surgical exploration revealed the true extent of the underlying muscle damage and within hours a flexor compartment syndrome developed needing surgical management. Through serial operating room visits and directed antibiotic therapy we were able to successfully treat the patient resulting in a favorable outcome.

Key words: African Nile crocodile bite, Crocodile bite of the extremity, Nile crocodile bites in Africa

INTRODUCTION

African Nile crocodile bites are a common occurrence across the African continent with several studies reporting an increasing incidence (1-3). In terms of quantifying the magnitude of this increasing African problem one study from Malawi by Vanwersch (3) reported 60 patients admitted over a four-year period with African Nile crocodile inflicted trauma. Another world-wide database that considered Uganda reported 69 African Nile crocodile bites and confirms an increasing incidence (4). Another study from Tanzania by Scott *et al* (1) reported 51 people being killed by African Nile crocodiles over a five-year period. Not unique to Africa a similar, albeit significantly less frequently occurring problem considering the total number of attacks, is reported from Australia where data from a national computed database reported 87 Salt-water crocodile attacks over a period of 4 decades (5). Several studies (1,6,7) note that many African Nile crocodile attacks are not reported and hence the exact scale of this problem is in fact unknown. Geographical and cultural differences underpin the varied causes contributing to these attacks and factors implicated include an increasing human population, habit encroachment, tourism, and regional religious beliefs (1,8,9). Local superstition contributes to increasing African Nile crocodile populations such as beliefs that a tamed African Nile crocodile is unable to be killed and the belief that if one kills an African Nile crocodile his son will be targeted by the local crocodile population (1).

CASE REPORT

We report an adult male patient who, by being a professional hunter by occupation, put him in close proximity to African Nile crocodiles while performing his daily duties. The history provided by the patient was that on a typical African hot summer's day, while casually walking along a river embankment, he lost his foothold, slipped, and fell into the water. Upon entering the water he was immediately seized on the left forearm by an African Nile crocodile which he estimates to have been approximately three meters in length. The clamping action was maximal instantaneously and the African Nile crocodile began to thrash from side to side while simultaneously attempting to drag him into deeper waters. Instinctively he used all his strength and fortunately managed to pull his arm free from the animal's mouth. He scrawled up the river bank and was assisted by a work colleague until paramedic staff arrived.

On presentation to our unit we noted a healthy looking young male patient in obvious pain with an isolated crocodile bite to the left forearm. On inspection his left forearm was swollen with several deep puncture holes in both the flexor the extensor

compartments (Figures 1-2). The forearm was neurovascularly intact however he resisted all wrist and finger movement secondary to pain. At admission there were no symptoms or signs of a compartment syndrome. An X-ray of his left forearm was performed and was normal.

Figure 1

Pre-operative patient photograph of the left forearm showing a deep puncture wound in the proximal part of the extensor compartment. Sand from the river bank is noted as the wound had not been cleaned

Figure 2

Pre-operative patient photograph of the left forearm showing additional puncture wounds on the lateral side of distal left forearm involving both the extensor and flexor compartments

He was immediately taken to the operating room for wound debridement and copious irrigation and upon surgical exploration the true extent of the injury was appreciated which demonstrated extensive crushing muscle damage not clinically evident at the initial examination (Figures 3-4).

Figure 3

Intra-operative photograph of the patients left forearm post debridement demonstrating the extensive muscle damage in the flexor compartment and the depth of the puncture wound from the proximal extensor compartment which had transversed the interosseous membrane and was visible within the flexor compartment (red arrow)

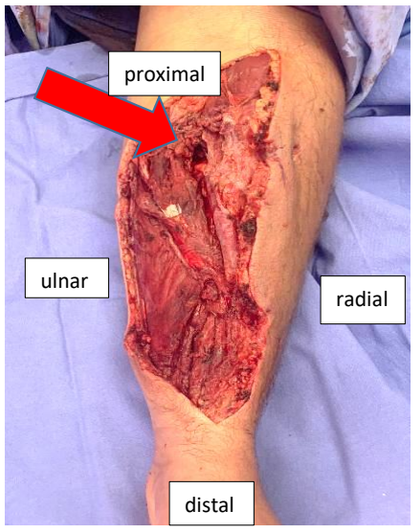
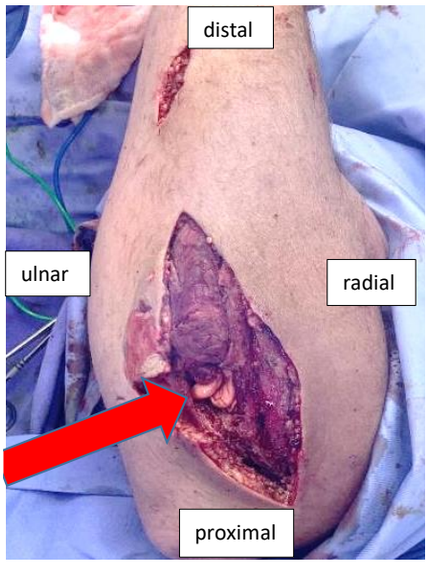


Figure 4

Intra-operative photograph of the left forearm post debridement demonstrating the extensive muscle damage to the proximal extensor compartment. In this photograph an antibiotic impregnated gauze is seen inserted into the transversing puncture hole (red arrow)



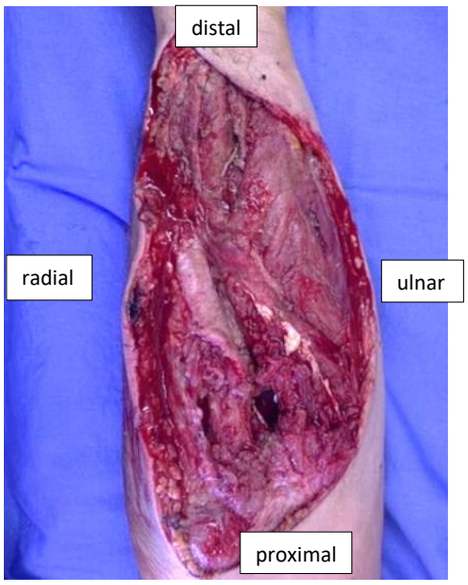
Post debridement the wounds were left open, a vacuum assisted closure dressing was applied, and the patient was taken to the Intensive Care Unit for

compartment checks. In the Intensive Care Unit he was given analgesia and commenced on empiric intravenous antibiotic cover, namely ceftriaxone 1g 12 hourly and metronidazole 500mg eight hourly, pending the results of the intra-operative pus swab.

Within hours he began to complain of increasing volar forearm pain and paresthesia in a median nerve distribution involving his thumb, index finger and lateral side of his third finger. Clinical examination suggested a compartment syndrome was developing in the flexor compartment. A doppler ultrasound was performed which confirmed intact radial and ulnar arteries with good flow. He was taken back to the operating room for an urgent flexor compartment fasciotomy (Figure 5).

Figure 5

Intra-operative photograph of the left forearm post flexor compartment fasciotomy releasing both the superficial and deep muscle compartments

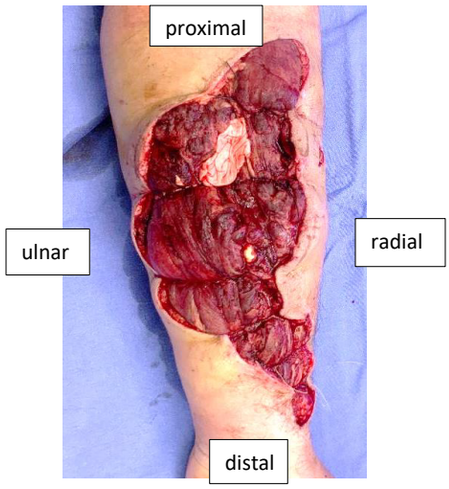


Post-operatively the vacuum assisted closure dressing was re-applied and the patient was transferred back to the Intensive Care Unit. Over the course of the next five days he was taken to theatre daily for wound debridement and irrigation. On the third day post admission the patient's pus swab result became available and on the anaerobic culture an Actinomyces species specifically *Actinomyces oris* was cultured which demonstrated sensitivity to co-amoxyclavulonic acid. The empiric antibiotic regimen was directed to co-amoxyclavulonic acid alone and this was continued for a further five days intravenously.

Post the daily operating room visits for the first five days the wounds demonstrated no signs of necrosis and no signs of infection. There was still significant muscle swelling precluding wound closure however the frequency of operating room visits was reduced to alternative days for a further 8 days during which sequential wound closure was performed (Figure 6).

Figure 6

Intra-operative photograph demonstrating one of the sequential wound closures of the volar wound. In this photograph the significant muscle swelling at the time can be noted



Daily C-Reactive Protein (CRP) and alternative day Procalcitonin (PCT) haematological investigations were utilized to exclude a rising trend that might suggest infection. The PCT was raised on the third post-operative day however reduced once directed antibiotic therapy was employed and remained so through-out the remainder of his in-patient stay. In total the patient was taken to the operating room nine times and on the last visit a tension free wound closure was achieved (Figures 7-8).

Figure 7

Intra-operative photograph of the left forearm taken at the final operating room visit demonstrating the volar wound successfully closed utilizing vertical mattress sutures

Figure 8

Intra-operative photograph of the left forearm taken at the final operating room visit demonstrating that the wound over the extensor compartment has been successfully closed utilizing the visible vertical mattress sutures proximally

The patient underwent an intensive period of in-patient physiotherapy and was discharged three weeks post the attack for continued out-patient physiotherapy. At his 6 week out-patient appointment he had a full range motion of his forearm as well as a full range of movement of all his fingers and his wounds had healed well (Figures 9-11). A decrease in left hand grip strength compared to that of his right hand was documented however with ongoing rehabilitation and muscle strengthening this is expected to improve.

Figure 9

Patient photograph of the volar surface of the left forearm at his 6 week follow-up appointment demonstrating the healed volar wound

Figure 10

Patient photograph of the extensor surface of his left forearm taken at his 6 week follow-up appointment demonstrating the healed wound

Figure 11

Patient photographs at 6 weeks post discharge showing full range of motion of elbow, wrist and fingers

DISCUSSION

While 23 distinct crocodile species exist world-wide only one species, *Crocodylus Niloticus* (Nile crocodile), is found in stable populations across central and sub-Saharan Africa. While listed as an endangered species in the 1970's, resulting in their inclusion at the signing of the International Convention of Endangered Species treaty in 1982 whereby they are to date protected, the last four decades have seen populations increasing substantially across the continent. The

African Nile crocodile is reported in several studies to be the predominant species responsible for human deaths across Africa due to their wide distribution, significant size, and increasingly frequent proximity to human settlements (10,11). The hunting strategy of the African Nile crocodile is that of a surprise attack whereby utilizing their powerful tail to rapidly accelerate from underwater they suddenly emerge and take a firm grasp on an unsuspecting victim. They then violently shake the victim side to side to stun him/her, rapidly roll the victim onto his/her back, and then pull the victim underwater to drown (11,12). Another study by Fukuda *et al* (5) which analyzed a 42 year database considering 87 attacks confirmed drowning to be the predominant mechanism of death.

Globally the mortality rate of a Nile crocodile attack is reported to be in the region of 65% however local factors in the African situation, such as a lack of immediate transport and availability of medical care, has seen much higher mortality rates being reported (11). One such study that considered African Nile crocodile attacks in Uganda over a five-year period reported a 91% mortality rate (4).

Considering limb bites, in patients that survive the bite injury itself and reach hospital, the wound is described as crushing in nature and better described as degloving. Several studies report that approximately 70% of afflicted limbs ultimately require amputation (2,11). The relatively small puncture sites commonly mask significant underlying muscle damage and may or may not be associated with a fracture (2). Regarding our patient this was exactly the case where despite relatively small puncture sites significant muscle damage was noted on surgical exploration (Figures 1-4). Besides the mechanical crushing of the tissue bacterial inoculation into the wound at the time of the bite is another important consideration. The oral flora of a crocodile that are inoculated into the wound, but in many cases also lead to infection, are extremely varied. Despite a wide range of species a predominance of gram negative aerobic and anaerobic bacteria rather than gram positive species have been reported across several studies (11, 13-16).

In terms of the initial management of a patient with an African Nile crocodile bite to a limb the literature describes resuscitation, prophylactic tetanus prevention, empiric antibiotic therapy, fracture stabilization with an external fixator, and early surgical debridement as essential interventions. Intravenous ceftriaxone, metronidazole as well as oral doxycycline are considered an appropriate empiric antibiotic regimen that should be used. Repeated wound debridements and directed antibiotic therapy are advocated secondary measures (2). In our patient we utilized intravenous ceftriaxone and metronidazole without doxycycline as our empiric antibiotic regimen. In addition to these medical measures our patient was taken to the operating room nine times. We believe that our adherence to standard surgical principles regarding the management of a contaminated wound with a high index of suspicion which prevented infection resulted in a favourable outcome.

CONCLUSION

Despite predictably avoiding mortality due to the circumstances of the attack we describe a young male patient who presented to our Unit with an African Nile crocodile bite of the left forearm. Despite the benign appearance of the skin wounds the initial surgical exploration demonstrated a very real possibility of amputation if secondary complications were not timeously addressed. We advocate frequent operating rooms visits as the primary surgical technique to be employed in the management of African Nile crocodile bites of the extremities.

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