

## CASE REPORT

# Hippopotamus bite morbidity: a report of 11 cases from Burundi

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## Abstract

Hippopotamus is one of the most-loved animals in Africa, yet it is aggressive and dangerous. The co-existence of humans in close proximity to their natural habitat increases the probability of human injury. Hippopotamus attacks have long been recognized to cause serious injuries, but its magnitude and burden are still unknown. The medical literature is very scarce when it comes to documenting hippopotamus bite injuries and their outcomes. We present a cohort of 11 patients who suffered hippopotamus bite injuries in Burundi. To our knowledge, this is the largest case series reporting on the clinical presentation, injury patterns and surgical outcomes of hippopotamus bites. The results show a high incidence of wound infections, amputations and permanent disability among other complications. Hippopotamus-inflicted injuries should, therefore, be triaged as major trauma rather than just ‘mammalian bites’.

## INTRODUCTION

Hippopotamus is one of the most-loved of all African animals, yet it is aggressive and listed as one of the most dangerous animals in sub-Saharan Africa [1]. The close proximity of humans to the hippopotamus’ natural habitat increases the probability of human injury. While this risk has long been acknowledged, its magnitude remains uncertain.

Two published reports point to the high case fatality ratio following hippopotamus attacks [2,3], but the literature is scarce when it comes to patterns of injuries and outcome. To our knowledge, only two case reports described surgical care for a patient attacked by a hippopotamus [4,5].

The adult hippopotamus is massive: 3.5 m long, 1.5 m tall, and weighing approximately 3200 kg [6]. The animal’s mouth is 50 cm wide and can open 150°; it is equipped with very sharp triangular lower canines each measuring 30–50 cm. Hippopotamus bite force measures 12 600 kPa. By comparison, a lion’s bite force is only 4500 kPa. The hippopotamus, with his ferocious jaw force, unique mouth size and sharp teeth, can easily bisect a human body in a single bite [7].

Médecins Sans Frontières (MSF) is a humanitarian medical organization providing surgical care in many sub-Saharan Africa countries. MSF serves populations in direct contact with wild animals in limited-resource settings. Animal bites are one of

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Received: April 22, 2020; Accepted: June 19, 2020

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the life- and limb-threatening emergencies requiring urgent surgical care.

The aim of this study was to describe the clinical presentation and outcomes of a series of patients presented with hippopotamus bites in an MSF-run hospital in Burundi.

## METHODS

We conducted a retrospective patient-file analysis of routinely collected program data.

This study was conducted in Arche Hospital (Arche Médicale de Kigobe), Bujumbura, Burundi, which is a trauma hospital operated by MSF. The hospital is staffed by national general physicians and nurses and expatriate specialists.

The study included all patients who presented to the emergency department (ED) between 1 January 2017 and 31 December 2018 with hippopotamus bites.

Demographic data were retrieved from an Excel database. Clinical data for each subject were obtained by performing chart review. Information collected included patients' demographics, time of injury, triage severity code using the five-level triage scale—START (Simple Triage And Rapid Treatment), wound location, skeletal injuries, peripheral vascular and neurological status, organ injuries, blood transfusions, surgical procedures, readmissions and surgical outcomes (wound infections, amputation).

Initial wound care was performed according to the Red Cross principles of war wound management [8]. Considering the wound site and size, most wounds were managed in a two-stage process: wound debridement or excision, leaving the resulting wound open; then, delayed closure was carried out if no wound infection developed.

'Penetrating wounds' described deep wounds communicating with cavities like chest cavity, abdominal cavity or joint cavity. MSF protocols were followed for prophylactic antibiotics, tetanus immunization, and rabies post-exposure prophylaxis. Open fractures were treated by debridement and application of external fixator when possible, according to MSF policy [9]. Deep infection was defined as existence of one or more of the following signs: pus/foul drainage, swelling/inflammation, fever above 38°C and heat at the site.

## RESULTS

During the two-year study period, 11 cases of hippopotamus bites presented in the ED. Nine were males and two were females. The mean age of the patients was 31 years, with a range of 18–57 years. Most of the injuries happened at a body of water either a river or Lake Tanganyika: three were injured while swimming, two fishing and one while washing clothes; two patients were injured while farming, and three patients had no data. The time lapse from onset of injury till presentation at ED ranged from 30 min to 24.5 h. Nine patients had data on the time of injury, of whom seven were injured during day light and two during the night (between sunset and sunrise). Four out of 11 cases were triaged as 'Red'—proxy for high urgency, four were 'Orange' and three were 'Yellow'.

All cases were admitted to the hospital after appropriate resuscitation and initial wound care in the ED. The mean hospital length of stay was 18.6 days (range 3–57 days). Two patients required readmission; of them one was re-admitted twice. Of all, six patients required a blood transfusion (450 ml = 1 unit whole blood) with an average of 3.7 units per patient (range 2–8 units).

All patients required surgical interventions in the operating room, and three needed laparotomy. Wounds were distributed across several parts of the body (Table 1). Lower limbs injuries were most common in eight patients (two had bilateral injuries), followed by the upper limbs in five patients (two had bilateral injuries). Four patients presented with penetrating wounds in the abdomen and chest. Three patients presented with open long bone fractures.

Deep wound infection occurred in five patients; two cases progressed to chronic osteomyelitis. Four patients required limb amputation due to traumatic ischemia, three of whom had open fractures and one a laceration at the popliteal fossa.

All patients were discharged and no mortality occurred. Six patients suffered permanent disabilities at discharge (Table 2). Four patients had no permanent disabilities and for one there were no data.

## DISCUSSION

To our knowledge, this is the first case series reporting on the clinical presentation and outcome of the largest cohort of cases (11 cases) of hippopotamus bites in Africa. To date, there are only three published reports of hippopotamus bites in the medical literature discussing a total of six cases [4,5,10].

Our data showed that during 2017–2018, animal bites represented 0.6% of the overall emergency department visits, of which 8% was caused by hippopotami.

The incidence of deep wound infection in our series was 36.4%. Animal bite wound infections are reported to be between 2 and 64% in the literature [11]. The relatively high infection rate reported in our series could be explained by crushing trauma rather than the commonly described bite wounds of scratches, punctures and avulsions [11]. Crushing can devitalize tissues far beyond clinical identification during surgical debridement of wounds. Hippopotamus saliva could also play strong role in wound infection. The mammals are known to have powerful salivary digestive enzymes (lysozyme and peroxidase) that can chemically damage human flesh. Furthermore, oral bacterial flora inoculated during biting could be particularly virulent in human tissues [12]. Due to the limited resources in our practice, we were unable to isolate the causative organisms. Delayed presentation could be an added factor.

Amputation was required for four patients; three had open fractures. This high rate of post-traumatic ischemia may reflect the extent of soft tissue damage caused by these animals. Lin *et al.* [4] reported acute traumatic ischemia in one patient who required vascular repair by specialized team. Their patient received 34 units of packed red blood cells and 16 units of fresh frozen plasma during this limb-saving procedure. Drake *et al.* [5], on the other hand, decided to perform an amputation for their reported case. Our hospital set-up is neither equipped with vascular imaging machines nor staffed with specialized surgeons to do sophisticated vascular repairs, so amputation was the safest option for our patients.

We reported three cases of limb fractures in our series, all of which were open. Pickles reported the management of four cases; two of which presented with open fractures [10]. Lin *et al.* [4] and Drake *et al.* [5] each reported one case of open fracture. Our data confirm that limb fractures resulting from Hippopotamus attacks will most likely be open.

The human mortality rate from hippopotamus attacks is unknown but it is estimated to range from 500 to 3000 per year [1]. This estimate comes from a few non-medical published

**Table 1:** Characteristics of the wounds and fractures of patients with hippopotamus bite at Arche Hospital (Arche Médicale de Kigobe), Bujumbura, Burundi

Case ID	Wound sites					Penetrating wound			Deep injuries			Fractures		
	Head & face	Abdomen & pelvis	Chest	Upper limb	Lower limb	Chest	Abdomen	Joint	Organ injury	Vascular injury	Others	Yes/No	Open	Site
01	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Emphysema	Yes	Yes	Femur & ribs
02	No	No	No	Yes x 2	No	No	No	No	No	No	No	Yes	Yes	Radius & ulna (bilateral)
03	No	No	Yes	Yes	Yes	Yes	No	No	No	Yes	Pneumothorax	Yes	Yes	Humerus & ribs
04	No	No	No	Yes	No	No	No	No	No	No	Cut hand tendons	No	–	–
05	No	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Evisceration spleen tear	No	–	–
06	no	No	No	No	Yes	No	No	Yes	No	No	Open knee	No	–	–
07	No	No	No	No	Yes	No	No	No	No	Yes	Compartment syndrome	No	–	–
08	No	No	No	No	Yes	No	No	No	No	No	No	No	–	–
09	No	Yes	Yes	No	No	No	Yes	No	No	No	No	No	–	–
10	No	No	No	No	Yes x 2	No	No	No	No	No	Thigh muscle laceration	No	–	–
11	No	No	No	No	Yes x 2	No	No	No	No	No	No	No	–	–

**Table 2:** Complications and disabilities among patients with hippopotamus bite at Arche Hospital (Arche Médicale de Kigobe), Bujumbura, Burundi

Case ID	Complications and disability			
	Deep wound infection	Amputation	Disability	Type of disability
01	Yes	No	Yes	Osteomyelitis of femur, stiffness of the knee
02	No	No	Yes	Stiffness of the left forearm
03	No	Yes (unilateral upper limb)	Yes	Limb amputation
04	No	No	No	No data on functional recovery but wound was well healed
05	No	No	No	No
06	Yes	Yes (unilateral lower limb)	Yes	Limb amputation
07	Yes	Yes (unilateral above-knee)	Yes	Osteomyelitis, Limb amputation
08	No	No	No	No
09	No	No	No	No
10	No	No	No	No
11	Yes	Yes (unilateral above-knee)	Yes	Limb amputation

papers; we did not find data in the medical literature regarding fatality rates. Treves *et al.* [2], in their retrospective study analyzing the data of wildlife-caused casualties over 58 years, found that hippopotamus attacks produced the highest percentage of fatalities (86.7%) compared to lion and leopard attacks (75.0% and 32.5%, respectively).

Hippopotami are one of the main tourist attractions in Africa, and attacks on tourists tend to get a lot of media attention. For instance, the Australian Broadcasting Corporation reported the death of 13 people while on a boat trip due to a single hippopotamus attack [13]. A total of 18 people were aboard this boat, translating into a death rate of 72%.

The probability of being killed by a hippopotamus attack (case fatality rate) is thought to be in the range of 29 to 87% [2,6]. This compares to a death rate following a grizzly bear attack of 4.8%, shark attack at 22.7% and crocodile attack at 25%, all of which indicate that a hippopotamus attack is far more dangerous encounter than the public knows and media publicize [14–16]. In our study, we received 11 patients over 2 years who

had survived hippopotamus attacks and were medically stable enough to reach our hospital from distant villages using public and private transportation. We were unable to know how many deaths occurred on the spot or before reaching our facility, but it may be extrapolated from the published ratios; we calculated that between 5 and 74 people may have died before reaching the hospital.

Our results highlight several important operational lessons. First, the high incidence of hippopotamus bite wound infection should raise a red flag to all treating surgeons to be more aggressive in the wound debridement considering them as crushing injuries rather than penetrating wounds. This has a significant impact on patient outcomes where patients are at risk of chronic osteomyelitis and permanent disability. Second, hippopotamus injury to the limbs carries a high risk of amputation so a meticulous assessment of peripheral circulation on arrival and close observation for several hours afterwards should be part of the treatment strategy. Third, hippopotamus bites are serious injuries as many patients required blood transfusions

and complex orthopedic interventions, which may not be available in low-resource settings. Fourth, almost half of our patients had a permanent disability at discharge, which has not been reported in the literature to date.

A future study should be designed to identify the causative organisms involved in these wound infections to better inform appropriate antibiotic choices. In particular, hippopotamus mouth flora has not been studied and would provide useful information. In view of the high mortality and case-fatality rates ensuing from hippopotamus bites and other dangerous mammals in sub-Saharan Africa, we call for increased surveillance of this public health risk and greater sensitization of local populations and tourists to danger zones and situations.

## CONCLUSION

Based on our limited case series, we believe that hippo-inflicted injuries should be triaged as major trauma rather than 'mammalian bite'. Our data show that the severity of injury as indicated by the START score, requirement for blood transfusion, length of hospitalization, incidence of chest and abdominal trauma, high incidence of wound infection, osteomyelitis, laparotomy, amputation and permanent disabilities would put this injury in a special group of life-threatening animal attacks. Surgeons in rural hospitals should take them very seriously.

## ACKNOWLEDGEMENT

We would like to thank Marta Balinska and Tony Reid for their editorial help.

## CONFLICT OF INTEREST

None to be declared.

## FUNDING

Not required.

## ETHICS APPROVAL

The study received approval from 'National Ethics Committee for the Protection of Human Beings Participating in Biomedical and Behavioral Research' of Burundi, and met the exemption criteria set by the Ethics Review Board (ERB) of MSF (Geneva, Switzerland) for a-retrospective analyses of routinely collected data. Informed consents were not required.

## GUARANTOR

Moustafa Haddara is the guarantor of this study.

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