Case Report

Patient survival and limb salvage after shark attack with major vascular injury: A case report

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Abstract

Shark attacks are rare unique pathological processes. Some of them represent devastating injuries with a high morbidity and significant mortality. Related published articles are limited. The increased human interaction within the environment of sharks is the cause of rising incidence of such attacks. This study reported a case of level 4 shark injuries (shark-induced trauma scale) in a 33-year-old male patient, who presented with an extensive injury of the right lower limb with the characteristic features of shark bite. At admission the patient was in a state of shock with profuse bleeding that was controlled by tourniquet. The patient was resuscitated according to the advanced trauma life support. Clinical examination showed hard signs of vascular injury with absent pedal pulse, associated neurological deficits and severance at the knee joint. Prompt vascular intervention after resuscitation was performed to manage the major vascular injuries, together with proper washout and debridement of all the necrotic tissues under strong antibiotic coverage to prevent infection. After that, the patient underwent sequenced plastic, orthopedic, and neurological interventions. Strict follow-up was conducted, which showed that the patient was saved and achieved a functioning limb. This study aims to highlight the management of level 4 shark injuries, which are considered serious and challenging with a high fatality rate and a great risk of amputation due to the associated major vascular injuries. Immediate well organized management plan is crucial. Prompt resuscitation and surgical intervention by a highly-skilled medical team are required to improve the chance of patient survival and limb salvage.

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Introduction

Increased human interaction within the environment of sharks increased the numbers of shark attacks; however, such attacks still constitute rare events and most of them are minor injuries. The media attention including shark movies led to the public perception of its fatal property.

Some of shark attacks represent devastating injuries with a high morbidity and significant mortality; however, they are rare unique pathological processes, and the published articles are limited. The challenges during management of such injuries include exsanguination, shock, specific injury pattern and infection with multimicrobial flora, especially marine Vibrio species. With the presence of marked tissue devitalization, infection constitutes a very serious threat.

Case report

A 33-year-old male patient was attacked by a shark during water skiing at noon (1:00 p.m.). He was transferred to our department at 2:00 p.m. with extensive injury of the right lower limb. The patient was shocked with profuse bleeding that was controlled by tourniquet at the scene of accident, after getting him out from water where he stayed inside for 10 min. The wound showed the characteristic features of shark bite as the serrated edges caused by the teeth, rectangular degloved skin, soft tissue loss and severance at the knee joint without any fracture (Fig.1A–C).

The patient was resuscitated according to the advanced trauma life support protocol and then he was given intravenous fluids and blood transfusion (the estimated amount of total blood loss was approximately 2 L) with oxygen support and correction of hypothermia and metabolic acidosis. Tetanus prophylaxis was also given. Moreover an empirical combination of broad spectrum antibiotics was started simultaneously, until the results of culture and...
sensitivity test revealed the causative organisms, to prevent infection in such heavily contaminated wounds.

By physical examination there were hard signs of vascular injury with absent pedal pulse and associated neurological deficits in form of foot drop, numbness, tingling and pain. The patient was rapidly investigated via plain X-ray and duplex ultrasound, which showed distal ischemia, but there were no bony fractures.

Prompt surgical intervention was decided and we performed proper washout and control of the bleeding coming from the injured genicular arteries, muscular branches and the great saphenous vein. Then exploration of the vascular structures at the popliteal fossa revealed an injury of the popliteal vein for which primary repair was successfully done. Thus we had to explore the popliteal artery using Fogarty catheters, via transpopliteal approach, as the artery was collapsed and not pulsating and the preoperative duplex showed distal ischemia. Arterial spasm was found, which was managed by flushing with heparinized saline (50 units/mL), Nitronal (GTN 1 mg/mL in a dose of 100 µg) and balloon dilatation, together with dissection of the adventitia. These procedures were effective and the patient obtained return of good pedal pulse at the end of operation (Fig. 2A–C).

Thorough debridement of all the necrotic tissues was conducted. Primary fasciotomy was of paramount importance to decrease the incidence of compartmental syndrome. Then the severely lacerated muscles were reconstructed and the skin was repaired as much as possible (Fig. 2C). Management of the more complex injuries of the knee joint and associated nerves (common peroneal nerve and some important branches of the tibial nerve) was postponed to be done in a second session. In the postoperative period, the patient continued on low molecular weight heparin (Enoxaparin 80 mg subcutaneously every 12 h) and strong antibiotic combination (Imipenem/Cilastatin vials 500 mg/8 h, Linezolid 600 mg vials every 12 h and Metronidazole 500 mg vials/8 h. After the results of culture and sensitivity, the medication was shifted to fluoroquinolone: Levofoxacin 500 mg/12 h) with strict follow-up of his leg as regards the vascularity and the possibility of infection.

According to the shark-induced trauma scale, our case was classified as level 4 injuries, which means an aggressive shark attack with a high incidence of fatality due to the major vascular injuries. Immediate resuscitation and surgical intervention were required to save the patient. The postoperative course was uneventful and clinical examination and duplex ultrasound showed that the patient had consistently good blood flow. There was no apparent severe infection but the patient needed further debridement and skin grafting to cover the residual raw areas (Fig. 3A). Also, successful management of his complex knee injury and the associated nerve injuries was done in a sequenced plan. The patient could walk again with a fairly-functioning limb, except for residual foot drop, with the help of appropriate physiotherapy and
psychological support (Fig. 3B). The hospital stay was 12 weeks and the mean follow-up period was 36 months.

Discussion

Depending on the data collected by the International Shark Attack File at the University of Florida, shark attacks are rare events and most of them represent minor injuries; serious and fatal injuries constitute only 20% of all injuries. The shark-induced trauma scale has been developed as the shark bite severity scoring system, which assesses the injury patterns and predicts the clinical outcomes, offering a great help in the management plan. According to shark-induced trauma scale, there are 5 levels of shark injuries: minor injuries include levels 1 and 2, moderate injuries level 3, and serious and fatal injuries levels 4 and 5. The overall mortality of shark attacks was 8.3%.6,7 Our case ranked level 4, having a great risk of mortality due to the associated major vascular injury.

Some unique challenges are encountered in management of such serious injuries, including immediate resuscitation and surgical intervention to control the life-threatening blood loss, revascularizing the limb, and reconstruction of the more complex wounds thus decreasing the incidence of early mortality and limb amputation. The early use of tourniquet in such injuries contributes to patient survival.8,9 Infection is also a very important challenge, which increases the incidence of morbidity and delayed mortality due to sepsicemia and multiple organ failure, and should be prevented by proper washout, thorough debridement, strong antibiotic coverage, and continued follow-up.10

In conclusion, prompt resuscitation and surgical intervention by a highly-skilled medical team is required to improve the chance of patient survival and limb salvage following shark attack. Moreover it should be taken into consideration that the high possibility of infection represents a very serious threat to the clinical outcome of such challenging injuries.

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Fig. 3. (A) The wound healed after skin grafting; (B) The patient can walk with support due to foot drop.

Ethical statement

The study protocol was approved by the Local Medical Ethics Committee. Informed consent was obtained. The author had the patient consent to publish the manuscript and its accompanying photos after explaining the importance of this in research work and hence the benefit of patients.

Declaration of competing interest

No benefits have been received from a commercial party related directly or indirectly to the subject of this manuscript.

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