



Volkman's Ischaemic contracture following delayed antivenom administration: A case report

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Abstract

Snake envenomation is a serious health problem in Malaysia however it rarely causes compartment syndrome directly. Local envenomation will result in swelling, blistering and necrosis, while systemic envenomation will result in bleeding diathesis, hypotension and shock. Specific anti venom is required to reverse the symptoms of progressive oedema, coagulopathy and tissue necrosis, nevertheless delayed and inappropriate anti venom may prove devastating. We reported a case of king cobra (*Ophiophagus hannah*) bite on a patient who developed compartment syndrome. Even though fasciotomy and debridement has been performed, the patient still developed complication of Volkman's Ischaemic Contracture (VIC).

Keywords: volkman's ischemic contracture, compartment syndrome, fasciotomy

Introduction

Permanent flexion contracture of the hand resulting in claw-like deformity, as described by Richard von Volkman (1881), is a consequence of acute ischemia and muscles necrosis. Compartment syndrome, brachial artery obstruction, probably due to improper use of plaster cast or tourniquet has been identified as the causative factors^[1]. The underlying pathophysiology is increased intra-compartmental tissue pressure which exceeds the capillary perfusion pressure. Many factors contribute to increased intra-compartmental tissue pressure; one of those is snake envenomation. Although snake envenomation rarely causes compartment syndrome, the toxin itself might lead to devastating life threatening condition^[2]. We reported a case of delayed treatment of snake envenomation that resulted Volkman's ischemic contracture. This eventually caused permanent disability to the patient.

Case Report

A 29-year-old zoo keeper who routinely takes care of the snakes was admitted to our hospital. He had no previous significant medical or surgical history. He was bitten on dorsal aspect of the left wrist by a king cobra (*Ophiophagus hannah*, Elapidae family) while handling it. He was brought to the emergency department in less than thirty minutes after the bite. He complained of intense pain over the left forearm with Visual Analogue Scale (VAS) of 8/10. His Glasgow Coma Scale (GCS) was 15, heart rate 98 beats per minute, blood pressure 132/88 mmHg, body temperature 37.5°C, and SpO₂ of 98%. There were two fang marks over dorsal aspect of left wrist. The oedema was extending from the left hand to almost the whole arm. Distal radial and ulnar arteries pulses were palpable and capillary refill time was less than 2 seconds. Despite administration of multiple analgesics, the patient still complained of severe pain. He could not actively move his wrist and fingers. He also had paraesthesia in addition to the pain. Venous access and 0.9% normal saline was quickly started, along with local wound cleansing and tetanus prophylaxis. Lab result showed blood

parameters were within normal range and so was the urinalysis. His electrocardiogram showed sinus tachycardia. After 2 hours, his body temperature rose to 38.5°C, heart rate was 115 beats per minute, blood pressure dropped to 108/60mmHg, but SpO₂ was 90% under room air. His left upper limb had doubled in size compared to the right side. As the GCS dropped to E2V3M3, generalized muscles weakness and respiratory distress developed, he was intubated and ventilated. The medical team decided to give king cobra anti venom, however the anti-venom stock for Elapidae family (i.e. cobra and king cobra) was not available in our hospital. Venom and Toxin Research Laboratory (VTRL) which is situated 300 km away from our hospital was contacted and they only had QSMI cobra anti venom. Thus, the patient was administered 7 vials of QSMI cobra anti-snake venom. We hoped cross neutralizing effect of cobra anti venom towards king cobra would happen, however, it was not effective. Twenty-four hours after the administration, the swelling didn't reduce but extended to the whole left arm, including axilla.

His left forearm became swollen and tense, both radial and ulnar arteries pulses became feeble. Left upper limb fingers became cold and dusky. Emergency fasciotomy of forearm and hand was performed. Intra-operatively, no muscle necrosis was found. Patient was then admitted to intensive care unit. He subsequently underwent four debridement procedures due to surgical site infection with necrosis of the extensor muscles. Finally he had split thickness skin graft to close the surgical wound.

Subsequent follow-up in our clinic three months later, patient presented with Volkman's contracture (figure 1). There was motor and sensory loss below distal third of left hand with clawing of the fingers. Physiotherapy failed to gain any improvement in function. On last follow up, he had discharging sinus over the dorsal aspect of the left wrist. Plain x-ray of the wrist showed osteomyelitis of proximal ulna, collapsed carpal joints and synostosis at proximal radio-ulnar joint (figure 2).

Table 1: Snake antivenom dosage as recommended by Ministry of Health, Malaysia in Management of Snakebite Guideline, 2017.

Snake	Common and scientific name	choice of antivenom	Initial dose of antivenom
Cobra	Monocled cobra (<i>Naja Kaouthia</i>)	QSMI Cobra Antivenin	Local - 5-10 vials Systemic - 10 vials Subsequent dose 1-2 hr
	Equatorial spitting cobra (<i>Naja Sumatrana</i>)	QSMI Cobra Antivenin (<i>Naja Kaouthia</i>) *cross neutralizing effect	Local - 5-10 vials Systemic - 10 vials Subsequent dose 1-2 hr
King cobra	King cobra (<i>Ophiophagus hannah</i>)	QSMI King cobra antivenin	10 vials Subsequent dose 1-2 hr



Fig 1: The typical presentation of Volkmann’s ischemic contracture of left hand and wrist with discharging sinus from dorsal aspect of the left wrist. Patient applied traditional medication over the sinus.



Fig 2: The x-ray taken on the last follow up showed osteomyelitis of proximal ulna, collapsed of carpal joints and synostosis of proximal radio-ulnar joint

Discussion

The principal cause of Volkmann’s ischemic contracture is compartment syndrome, resulting from increased pressure in a tight osteofacial space [3]. This pressure in turn will compromise capillary perfusion. Increased intra-compartmental pressure above 40 mm Hg (or less in children) would risk ischemic necrosis of muscles. Peripheral nerves surrounding the ischemic muscles will be affected as well. The neuropathy caused by ischemia leads to chronic pain, paraesthesia, apart from motor paralysis. In

hand, median and ulnar nerves neuropathy cause intrinsic muscle weakness; thus leads to intrinsic-minus or claw hand deformity [4]. Clinical presentations vary according to site and degree of compartment syndrome, degrees of muscle fibrosis as well as severity of nerves injuries.

Venom of king cobra (*Ophiophagus hannah*) and cobra (*Naja* species) primarily consist of neurotoxin with other compounds. Local envenomation will result in swell, ling, blistering and necrosis, while systemic envenomation will result in bleeding diatheses, hypotension, descending paralysis and shock [5]. It rarely causes compartment syndrome. However, tissue pressure measurement should be performed whenever possible to confirm compartment syndrome⁶. Extensive edema, tissue necrosis, bleeding, coagulopathy, neurological deficit, renal or cardiovascular complications are indications for immediate antivenom immunotherapy [5, 7]. Animal studies have shown that proper anti venom administration prevents myonecrosis and reduces intra-compartmental tissue pressure. Specific large amount of antivenom is required to reverse the symptoms from progressing. Phenomenon of recurrent envenomation could occur if antivenom is not maintained at adequate level in the circulation. In addition, antivenom is eliminated faster than the circulating toxin. This will subsequently lead to increased compartmental pressure [8].

The distribution of antivenom in regional hospitals in Malaysia is based on prevalence of snake bite in each hospital. Each hospital may have different stock of anti venom [9]. Satisfactory cross neutralization among anti venom is not well documented in elapidae envenomation. Not all physicians are well trained to manage snake bite cases [10].

In our case, we believe that clinical vigilance is necessary. The complication of Volkmann’s contracture is preventable, should the specific king cobra anti venom is available and given earlier. Fasciotomy should be deterred until specific anti venom has been completely administered [5, 7, 9]. Anti venom administration will reduce severe limb oedema, thus will prevent development of compartment syndrome. Debridement of necrotic tissue can be performed when the sign of clear demarcation has occurred.

References

1. Volkmann R. Die Ischaemischen Muskellahmungen und Kontracturen. Zentralbl Chir. 1881; 8:801-03.
2. Dinesh Dhar. Compartment Syndrome Following Snake Bite. Oman Medical Journal. 2015; 30:1-4.
3. Yamaguchi S, Viegas SF. Causes of upper extremity compartment syndrome. Hand Clin. 1998; 14:365-70.
4. Balakrishnan G. Ischaemic contracture of thehand. Indian J Plast Surg. 2006; 39:94-102.

5. Warrell DA. Treatment of bites by adders and exotic venomous snakes. *BMJ*. 2005; 331:1244-47.
6. Rajendra Kumar. Osteofascial compartment pressure measurement in closed limb injuries. *J Clin Orthop Trauma*. 2016; 7(4):225-228.
7. Larreche S, Mion G, Daban JL. King cobra envenoming [Correspondence]. *Anaesthesia*. 2007; 62:1076-77.
8. Gutierrez JM, Leon G, Lomonte B. Pharmacokinetic-pharmacodynamic relationships of immunoglobulin therapy for envenomation. *Clin Pharmacokinet*. 2003; 42:721-741.
9. Ismail AK. Snakebite management guide for healthcare providers in Malaysia. *Advanced Workshop on Marine Animal & Snake Envenomation Management (AMSEM) TM*. Updated, 2013.
10. Leong PK, Tan CH, Sim SM, Fung SY, Sumana K, Sitprija V, Tan NH. Cross neutralization of common Southeast Asian viperid venoms by a Thai polyvalent snake antivenom (Hemato Polyvalent Snake Antivenom). *Acta Trop*. 2014; 132:7-14.