Case Report

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# Compartment syndrome of arm secondary to snake bite on hand: a case report

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**Introduction:** Snake bites pose a significant common public health concern, with more prevalence in rural areas. Compartment syndrome (CS) is one of the rare and severe manifestations of snake bite wherein venom-induced swelling within a closed anatomical compartment leads to increased pressure, which may result in ischemic damage to nerves and muscle. Antisnake venom and prompt fasciotomy is recommended for management of CS secondary to snake bite.

**Case details:** Here, the authors report a case of 47-year-old female with Green Pit Viper bite on the left hand. Upon arrival to hospital, initial resuscitation measures were initiated. Six hours following the bite, there was severe pain on passive stretch and paresthesia. Ten vials of antisnake venom administration along with fasciotomy of hand and arm resulted in notable alleviation of pain and swelling. Eighteen pints of blood was transfused for coagulopathy and low hemoglobin. After continued care of wound and intensive physiotherapy, functional limb could be achieved.

**Discussion:** Snake bite envenomation is one of the biggest hidden health crises with case fatality rate of 7.8% in the southern plains of Nepal. As in our case, snake bites commonly affect upper extremities, accounting for around two third of all cases. CS must be differentiated from acute swelling, which sometimes may be difficult. Surgical decompression is indicated in presence of signs and symptoms of CS, in case of resource limited setting.

**Conclusion:** Multidisciplinary and prompt management with initial resuscitation, ASV administration, fasciotomy, and rehabilitative measures can save both life and limb in such cases.

**Keywords:** compartment syndrome, fasciotomy, green pit viper, snake bite

## Introduction

Snake bites pose a significant common public health concern, with more prevalence in rural areas[1]. There are over 5.5 million snake bite occurrences globally each year, with 421,000 envenomations and 20,000 fatalities as a consequence[2]. Compartment syndrome (CS) is one of the rare but severe manifestations of snake bite wherein venom-induced swelling within a closed anatomical compartment leads to increased pressure, which may result in ischemic damage to nerves and muscle[3,4]. Antisnake venom (ASV) and prompt fasciotomy is recommended for management of CS secondary to snake bite[5]. The work has been reported in line with the Surgical CAse REport (SCARE) 2023 criteria[6].

### HIGHLIGHTS

- Compartment syndrome is one of the rare and severe manifestation following snake bite.
- Signs and symptoms may even develop proximal to the bite site.
- Fasciotomy can be performed based on clinical diagnosis, in cases with no resources for intracompartmental pressure measurement.
- Multidisciplinary and prompt management can save both life and limb in cases with compartment syndrome.

## Case details

A case of a 47-year-old female presented with an alleged history of snake bite at the dorsum of left hand with a green pit viper. After the bite, the patient applied bandages around the bite site tightly for four hours (h) but the tourniquet was not applied. She presented to our emergency department with pain and swelling at the bite site.

Airway, breathing, and circulation was assessed and managed simultaneously. On examination, the general condition was fair and swelling was present at the bite site (Fig. 1). Fang marks were present in the left hand with profuse bleeding from the wound

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**Figure 1.** Tense swelling in left limb.

site. Respiratory, cardiac, abdominal, and nervous system examinations were within normal limits. On investigation, Prothrombin time (PT) was more than 3 minutes, international normalized ratio (INR) was more than 10, activated partial thromboplastin time (APTT) was more than 5 minutes and hemoglobin was 11.9 g/dl.

Ten vials of ASV, mixed in 400 ml of normal saline, were given intravenously for over one h. Multiple blood transfusion was done for active bleeding and deranged coagulation parameters. The patient was monitored regularly in view of development of complications. On re-evaluation of patient 6 h after snake bite, there was increased swelling in left arm and hand (Fig. 1) along with severe pain on passive stretch of flexor muscles of arm (biceps and brachialis muscle) and paresthesia of upper limb. Despite ongoing coagulopathy, emergency fasciotomy with anterolateral incision over the distal arm was performed for CS. As the swelling on the left hand was increasing, fasciotomy was performed with incision over the second and fourth metacarpal of the dorsum of the left hand. Following fasciotomy, the wound was left open with the view of delayed primary closure when appropriate (Fig. 2A). Regular dressing was done. Strict hand elevation at the level of heart was advised following fasciotomy. On the third postoperative day, the wound edges were temporarily apposed (Fig. 2B). On the sixth postoperative day, the wound was closed with placement of a negative suction drain. Drain was removed on the 12th postoperative day.

Patient was admitted to the ICU following fasciotomy for vigilance and appropriate treatment. Injection crystalline penicillin 1 million units four times a day and injection metronidazole 500 mg thrice a day were administered for 9 days followed by tablet cefuroxime 500 mg twice a day for 7 days. Hemoglobin started to decrease on the second postoperative day reaching lowest to 4.7 g/dl. Ultrasonography guided central venous catheter inserted at right internal jugular vein in view of difficult peripheral intravenous access (presence of edema in extremities) and need for multiple blood transfusions. Total 18 pints of blood was transfused during the hospital stay with six pints (1200 ml) of fresh frozen plasma (FFP) , one pint (150 ml) of platelet rich plasma (PRP), seven pints (2450 ml) of whole blood (WB) and four pints (1000 ml) of packed red blood cells (PRBC). PT, INR, APTT, and hemoglobin level returned to normal value after 11 days. Regular physiotherapy was done during the hospital stay.

The patient was discharged after 15 days, including 13 days in the ICU, due to clinical improvement and stable vitals. She had improved functional limb movement and PT/INR was within normal limits during regular follow-up. On 3 years follow-up, functional hand movement was preserved.

## Discussion

Snake bite envenomation is one of the biggest hidden health crises with an incidence of 251 per 100,000 and case fatality rate of 7.8% in the southern plains of Nepal[1,7]. As in our case, snake bites commonly affect the limbs, with the upper extremities accounting for around two third of all cases[5].

First aid for snake bite management now emphasizes on prompt evacuation to the closest medical facility rather than on field treatment. The use of tourniquet in management of snake bite is a common misconception. Although applying a tourniquet is believed to lessen the venom's return to the central circulation, it actually increases local edema and intensifies the venom's local effects by limiting vital blood supply to the affected region[8].

Majority of individuals following Green Pit Viper bite only have localized edema while some may get significant, potentially delayed systemic hemorrhage. The reason for hemostatic abnormalities was extended venom exposure due to delayed clearance and/or reabsorption, rather than acute venom antigenemia[9]. CS along with pulmonary edema, myocardial infarction, seizure are less frequent complication following viper snake bite. One out of 231 cases developed CS following viper snake bite[4].

In a study by Bozkurt *et al.*[5] over six years, one out of twelve cases developed CS requiring immediate fasciotomy. Development of CS is attributed to venom induced inflammation and swelling leading to development of local tissue ischemic and obstruction of distal perfusion[3]. Following snake bite to the hand, duration for development of CS varied from around 5 h–12 h[10,11]. In our case, there was an unusual presentation of development of CS proximal to the bite site, after 6 h of snake bite. Bite site was on the hand; however, the patient developed CS on the arm. Pain, paresthesia, pallor, paralysis, poikilothermia, and pulselessness are manifestations of CS, with intracompartmental pressure persistently higher than the normal range of 0–8 mmHg[8,12]. If there is a clinical suspicion of CS, prompt action is required since delaying the need for a fasciotomy might result in further tissue necrosis, ischemia consequences, and even


**Figure 2.** A. Incision left open following emergency fasciotomy (in view of delayed primary closure of wound). B. Postoperative management of wound.

limb loss[3,8,13]. The need for measurement of intracompartmental pressure for diagnosis of CS is unclear and it may vary according to institution[3,8,14]. In most of the institutions with limited resources, the device for measurement of intracompartmental pressure is unavailable. Likewise, we assessed our case based on clinical signs and symptoms and decided for doing fasciotomy based on clinical manifestation without measurement of intracompartmental pressure.

Predicting the development of CS is difficult. According to Hsu *et al.*[13], presence of leukocytosis and elevated aspartate aminotransferase at time of arrival to the emergency department may be useful in predicting CS and need for fasciotomy.

A few of the long-term and incapacitating characteristics of the ensuing wound problems include muscle and tendon contracture, gangrenous and necrotic tissue, osteomyelitis, and chronic wound infection[8].

## Conclusion

In addition to resuscitation measures, the clinician must always evaluate a patient for CS, despite its rarity, which may develop even proximal to the bite site. Multidisciplinary and prompt management with initial resuscitation, ASV administration, fasciotomy, and rehabilitative measures can save both life and limb in such cases.

## Ethical approval

Patient anonymity is maintained throughout this manuscript, and consent was obtained for publication from the patient. Ethical approval was not required as we are dealing with a single patient in this case report and as per our Institutional Review Committee (IRC), we don't require approval for case reports.

## Consent

Written informed consent was obtained from the patient for publication and any accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.


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## Author contribution

A.D.: visualization, manuscript writing, and manuscript editing; A.B.: manuscript writing and editing; R.S.: surgical procedure, patient care, manuscript writing, Guarantor; S.K.K.: manuscript editing; A.D.: patient care and manuscript editing; M.M.: manuscript editing; A.D.: manuscript editing; A.C.: manuscript editing.

## Conflicts of interest disclosure

All authors declare no conflicts of interest.

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## References


[1] Basnyat B, Shilpakar O. Snakebite envenoming: a hidden health crisis. Lancet Glob Health 2022;10:e311–2.

[2] Kasturiratne A, Wickremasinghe AR, de Silva N, *et al*. The global burden of snakebite: a literature analysis and modelling based on regional estimates of envenoming and deaths. PLoS Med 2008;5:e218.

[3] Kim YH, Choi J-H, Kim J, *et al*. Fasciotomy in compartment syndrome from snakebite. Arch Plast Surg 2019;46:69–74.

[4] Karlson-Stiber C, Salmonson H, Persson H. A nationwide study of Vipera berus bites during one year-epidemiology and morbidity of 231 cases. Clin Toxicol 2006;44:25–30.

[5] Bozkurt M, Kulahci Y, Zor F, *et al*. The management of pit viper envenomation of the hand. Hand 2008;3:324–31.

[6] Sohrabi C, Mathew G, Maria N, *et al*. The SCARE 2023 guideline: updating consensus Surgical CAse REport (SCARE) guidelines. Int J Surg 2023;109:1136–40.

[7] Alcoba G, Sharma SK, Bolon I, *et al*. Snakebite epidemiology in humans and domestic animals across the Terai region in Nepal: a multicluster random survey. Lancet Glob Health 2022;10:e398–408.

[8] Russell JJ, Schoenbrunner A, Janis JE. Snake bite management: a scoping review of the literature. Plast Reconstr Surg Glob Open 2021; 9:e3506.

[9] Rojnuckarin P, Banjongkit S, Chantawibun W, *et al*. Green pit viper (Trimeresurus albolabris and T. macrops) venom antigenaemia and kinetics in humans. Trop Doct 2007;37:207–10.

[10] Barani C, Mortamet G, Forli A. Upper limb compartment syndrome after a viper bite in a child: a case report. Hand Surg Rehabil 2021;40:97–100.

[11] Cavazos DR, Schultz R, Higginbotham DO, *et al*. Refractory compartment syndrome after antivenom administration for an Eastern Diamondback Rattlesnake bite requiring fasciotomy for limb salvage: a case report. Trauma Case Rep 2023;46:100852.

[12] Köstler W, Strohm PC, Südkamp NP. Acute compartment syndrome of the limb. Injury 2004;35:1221–7.

[13] Hsu C-P, Chuang J-F, Hsu Y-P, *et al*. Predictors of the development of post-snakebite compartment syndrome. Scand J Trauma Resusc Emerg Med 2015;23:97.

[14] Tillinghast CM, Gary JL. Compartment Syndrome of the Lower Extremity. In: Mauffrey C, Hak DJ, Martin MP III eds. Compartment Syndrome: a Guide to Diagnosis and Management. Cham (CH): Springer; 2019.