

Clinical presentation, outcome and management of snakebite cases in Saudi Arabia

Musa Suliman Alfaifi¹, Bader Al-Yahya², Atheer Eid Alotaibi¹, Hamdan Mujarri Alaklabi¹, Ibrahim AlHelali³, Ibrahim Al-Benhassan³, Ali Obaid Albshabshe⁴, Hadi Eissa Al-Ali⁵, Hasan M Alzahrani⁴, Nadia M Awaji⁶, Sami Alshehri⁴, Ali Yahya Darbi⁶, Mohammed S Alqahtani¹, Tim Patrick Moran⁷ and Brent W Morgan⁷

¹Department of Emergency Medicine, Armed Forces Hospital, Southern Region, Asir, Saudi Arabia (Correspondence to Musa Alfaifi: alfaifim@gmail.com). ²College of Medicine, King Saud University, Riyadh, Saudi Arabia. ³Abha Maternity and Kids Hospital, Abha, Saudi Arabia. ⁴College of Medicine King Khalid University, Saudi Arabia. ⁵Department of Emergency Medicine, Khamis General Hospital, Asir, Saudi Arabia. ⁶Department of Emergency Medicine, Asir Central Hospital, Asir, Saudi Arabia. ⁷Department of Emergency Medicine, School of Medicine, Emory University, USA.

Abstract

Background: Snakebite envenomation remains a significant public health concern in Asir Province of Saudi Arabia.

Aim: To characterize snake species and the clinical presentation, outcome and management of snakebite cases admitted to 4 major hospitals in Asir Province, Saudi Arabia.

Methods: This retrospective study reviewed medical records of paediatric and adult snakebite cases admitted to 4 regional hospitals in Saudi Arabia between January 2000 and December 2021 using search terms "snakebite", "cobra", "polyvalent antivenin", "antivenom", "compartment syndrome", and "fasciotomy". The data were analysed using R software version 4.2.

Results: Sixty-nine patients were identified, of whom 30 (43.5%) were children aged <18 years. Severe local or systemic manifestations occurred in 33 patients (47.8%) while compartment syndrome was suspected in 14 patients (20.3%), requiring fasciotomy in 11 (15.9%). The systemic manifestations included neurotoxicity (13 patients; 18.8%), coagulopathy (31 patients; 44.9%), rhabdomyolysis with creatine phosphokinase >1000 U/L (8 patients; 11.6%), and acute kidney injury (4 patients; 5.8%), with 2 progressing to end-stage renal disease. Three patients (4.5%) died. A majority (94%) received initial 5-vial antivenom dose, with 39% requiring additional doses. Antivenom-related adverse reactions were mild and transient in 6 patients (9%). Blood products and antibiotics were used in 30% and 67% of cases, respectively. Anticholinesterase therapy was administered to 3 patients (4.3%).

Conclusion: Snakebites pose a significant public health threat in Asir Province of Saudi Arabia. Antivenom, in addition to supportive care, remains the cornerstone of therapy, however, to optimize patient outcomes, our study highlights the need for a more comprehensive approach to management, as well as vigilant monitoring with prompt recognition and interventions.

Keywords: snakebite, systemic manifestation, compartment syndrome, antivenom, anticholinesterase, adult, paediatric, Asir Province, Saudi Arabia

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Introduction

Snakebite envenomation is a life-threatening disease with a global burden of 81 000–138 000 deaths annually (1). Children, agricultural workers and individuals living in impoverished rural areas are most at-risk (2–4). Forty-six venomous snake species have been identified in the Middle East (5) and 2 clinically significant families are present in Saudi Arabia: Viperidae and Elapidae. These 2 families include 9 venomous species: *Bitis arietans*, *Cerastes cerastes gasparetti*, *Echis carinatus sochureki*, *Echis pyramidium*, *Echis coloratus*, *Naja haje arabica*, *Walterinnesia aegyptia*, *Atractaspis microlepidota*, and *Atractaspis egaddensis* (5).

Asir Province in southwestern Saudi Arabia, has a surface area of 76 693 km² and an estimated population of 2 024 285 (in 2022) (6). Its diverse terrain, ranging from high-altitude grasslands to deserts, and

its distinct weather patterns with 2 rainy seasons, create a favourable habitat for most of these venomous species (5). An ecological study identified 14 snake species belonging to the Elapidae, Leptotyphlopidae, Colubridae, Typhlopidae, and Viperidae families, further highlighting the region's rich herpetofauna (7). A report identifies *Echis coloratus* and *Coluber rhodorachis* snakes in the Asir Province and acknowledges the possible underestimation of the Arabian Cobra (*Naja haje arabica*) and burrowing (*Atractaspis microlepidota*) snakebites due to pre-hospital fatalities (8). Compared to the global trend, a retrospective study identified a high prevalence of snakebite exposure among children in Saudi Arabia. The study found that 28 (42.4%) of the 66 patients were under-12-year-olds, indicating the vulnerability of this age group as reported in global data. Notably, children in the study exhibited more severe local and systemic complications than adults (9). The clinical presentations of snakebite

envenoming depend on the species of snake involved, the amount of venom injected, and individual susceptibility. The common local effects include pain, swelling and tissue necrosis. Systemic effects can range from mild nausea and vomiting to life-threatening neurotoxic, cardiotoxic, nephrotoxic, or haemostatic complications (10-12).

This multi-centre study, conducted at the 4 major referral centres in the Asir Province of Saudi Arabia, addresses critical knowledge gaps in snakebite envenoming management. The aim was to describe the types of snakes responsible for envenomation cases, characterise the spectrum of clinical manifestations experienced by patients, analyse treatment success and potential complications, and evaluate snakebite treatment practices in the province. We hope that this will provide valuable insights for improving the management of snakebite envenoming in Saudi Arabia and inform broader clinical practices. To the best of our knowledge, this is the first study to analyse neurogenic snake envenomation (snakes whose venom primarily affects the nervous system) and its management in a Saudi Arabian patient cohort.

Methods

This retrospective study reviewed medical records of all paediatric and adult snakebite cases admitted into 4 tertiary hospitals (Asir Central Hospital, Armed Forces Hospitals Southern Region, Khamis Maternity and Child Hospital, and Abha Maternity and Child Hospital) in Asir Province of Saudi Arabia from January 2000 to December 2021. We collected demographic data, including age and gender, along with any pre-existing medical conditions (comorbidities), as well as data on the envenomation event, including the suspected snake species (where available) and the clinical and laboratory findings observed in each patient. Data collection was done using standardized protocol and all information was validated before statistical analysis.

Cases were identified by searching the hospital archives using keywords "snakebite", "cobra", "polyvalent antivenin", "antivenom", "compartment syndrome", and "fasciotomy" as specified in the 10th revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10). Following the identification of patients through the electronic medical record (EMR), 2 independent reviewers conducted a retrospective review of the records. Data elements were then extracted and collated for analysis. We included snakebite cases that were confirmed either by a witness or involved a capture of the snake. We excluded cases with unconfirmed diagnoses, including cases that presented with symptoms or concerns suggestive of snakebite envenoming but were determined not to be snakebite after clinical evaluation and laboratory investigation, or cases with certain discrepancies.

Using Microsoft Excel we created a case report capturing the demographic characteristics, clinical manifestations, management, and patient outcomes. Neurogenic snakebites were defined as cases exhibiting neurologic manifestations such as ptosis, diplopia, respiratory or other muscle paralysis, and cardiac arrest preceded by neurogenic symptoms; based on witness description or patient recognition or description of the snake. Formal intra-rater reliability assessment was not performed because all diagnoses were subjected to consensus review.

Statistical analyses were performed using R software version 4.2 and were primarily descriptive. Categorical variables were presented as frequencies and percentages, while continuous or scale variables were described using medians and interquartile ranges.

Ethics clearance

Informed consent for publication was obtained verbally from all participants (or their authorized legal representatives for minors) involved in this study. The study protocol received ethics approval from the Institutional Review Board committee of the Asir Province Ministry of Health.

Results

Sixty-nine snakebite patients were identified; median age 22 years (IQR 6.5–32.5), male 77% and 13% with comorbidities (Table 1). Thirteen cases (19%) were classified by the medical team as neurogenic snakebites based on identified snake species (5 Arabian cobra bites) or neurologic manifestations (2 respiratory failures, 4 ophthalmoplegia and 2 cases with altered mental status). Peak bite occurrences were in the afternoon or evening hours (70%) and the summer season (39%) between June and August. Forty-nine percent of the patients reached the hospital within 6 hours of the bite, 22% within 6–24 hours, and 29% after 24 hours. Lower limb bites were most common (59%), with the left side of the body being slightly more affected (55%). Approximately 86% of patients required hospitalization.

Clinical presentations

Local manifestations

Among the 69 snakebite patients, 14 (20%) had severe local manifestations suggestive of compartment syndrome, while moderate, mild and absent local manifestations were observed in 16 (23%), 37 (54%), and 2 (3%) patients, respectively (Table 2, Figure 1).

Coagulopathy and bleeding

Thirty-one (45%) patients had coagulopathy, out of which 6 experienced bleeding: 3 with minor bleeding at the bite site, 1 subarachnoid and intracranial bleeding, 1 hematemesis and melena, and 1 pulmonary haemorrhage.

Table 1 Characteristics of patients exposed to snakebite, Saudi Arabia, January 2000 to December 2021

Characteristic	Frequency n (%)
Median age: 22 (range 6.5–32.5) years	
Gender	
Female	16 (23.2)
Male	53 (76.8)
Comorbidity	9 (13.0)
Asthma	4 (5.8)
Time of bite	
Morning	21 (30.4)
Afternoon	48 (69.6)
Season	
Fall	16 (23.2)
Spring	18 (26.1)
Summer	27 (39.1)
Winter	8 (11.6)
Time to reach hospital (hrs)	
<6	34 (49.3)
6–24	15 (21.7)
>24	20 (29.0)
Site of bite	
Lower limb	41 (59.4)
Upper limb	28 (40.6)
Left	38 (55.1)
Right	31 (44.9)
Percentage of patients requiring hospitalisation and reasons for admission	59 (85.5)
Major (severe local or systematic manifestations) out of total admission	33 (55.9)

Neurologic presentations

Thirteen (18%) patients showed neurologic features, defined by altered mental status, respiratory compromise, or ophthalmoplegia. Of these, 3 presented with mild diplopia, ptosis or breathing difficulties. The remaining 10 suffered moderate-to-severe presentations, ranging from confusion to respiratory paralysis and cardiopulmonary arrest. Altered mental status was the most common neurogenic manifestation.

Acute kidney injury

Four patients (6%) had acute kidney injury, 2 of whom required haemodialysis. The first patient, a 16-year-old male, presented 15 days after envenomation with a creatinine level of 28 mg/dl and haemoglobin 7 gm/dl. Haemodialysis was initiated and the nephrology team ultimately diagnosed end-stage renal disease. The second patient, a 57-year-old female with pre-existing chronic kidney disease, diabetes mellitus and hypertension, was bitten by a cobra and had respiratory paralysis and coma, requiring intubation and ventilation for 4 days. Her kidney function deteriorated and she required lifelong haemodialysis. The other two patients had acute

kidney injury after cardiopulmonary arrest, which was complicated by multiorgan failure and resulted in death.

Fatalities

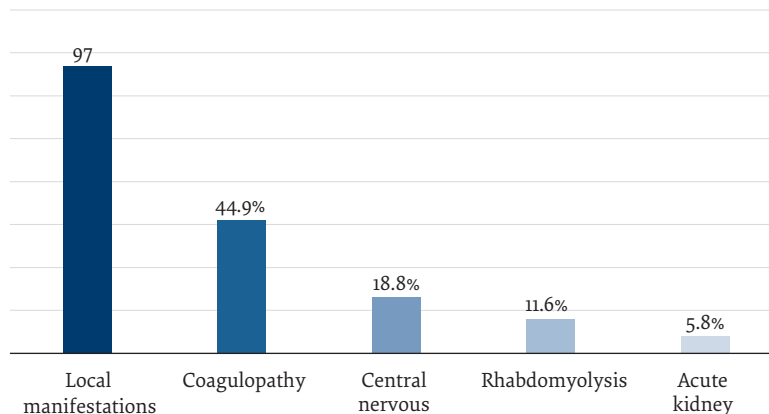
Three fatalities occurred:

- A 33-year-old healthy male bitten by a cobra experienced respiratory cessation and unresponsiveness enroute to the hospital. Cardiopulmonary resuscitation (CPR) was not initiated before arrival, and upon arrival, he was in asystole cardiac arrest. Advanced cardiovascular life support (ACLS) yielded a return of spontaneous circulation (ROSC) after 20 minutes. He received 30 vials of antivenom, 4 units of fresh frozen plasma (FFP), and 0.5 mg neostigmine intravenously but ultimately died after 24 hours due to multiorgan failure.
- A 30-year-old healthy male bitten by a black snake (unknown species) arrived within 30 minutes of envenomation but suffered ventricular fibrillation cardiac arrest. CPR lasted 35 minutes before death was declared. He received 10 vials of antivenom and 1 dose of neostigmine (0.5 mg) intravenously during CPR.
- A 5-year-old healthy female bitten multiple times on the left buttock by an unknown snake species went into cardiac arrest at a primary health care clinic within 30 minutes of envenomation. Resuscitation efforts

Table 2 Clinical manifestations of patients exposed to snakebite, Saudi Arabia, January 2000 to December 2021

Clinical manifestation	Frequency n (%)
Local manifestations	
Mild local (pain, local oedema, fang marks)	37 (53.6)
Moderate (necrosis, bleeding, extended oedema)	16 (23.2)
Severe (suspected compartment syndrome)	14 (20.3)
None	2 (3.0)
Central nervous system, total	
Difficulty breathing	4 (5.8)
Diplopia	2 (2.9)
Ptosis	1 (1.4)
Respiratory failure	5 (7.2)
Altered consciousness	9 (13.0)
Associated with coagulopathy	6 (8.7)
Chest pain	1 (1.4)
Heart rate Median 93 (range 79–113)	
Heart rate category	
Bradycardic	4 (5.8)
Normal range	47 (68.1)
Tachycardic	18 (26.1)
Systolic blood pressure, median 121.5 (range 114–130)	
Diastolic blood pressure, median 72.5 (range 67–79.5)	
Respiratory rate, median 20 (range 20–24)	
Coagulopathy	31 (44.9)
Bleeding	6 (8.7)

Figure 1 Clinical manifestations of snakebites, Saudi Arabia, January 2000 to December 2021



achieved ROSC, and she was transferred to a hospital where she died after 2 days. She received 110 vials of antivenom, 200 ml packed red blood cells (PRBCs), 400 ml FFP, 400 ml platelets, and 15 mg intravenous vitamin K. Death occurred on the fifth day of admission due to multiorgan failure.

Laboratory findings

Thirty-one (45%) patients presented with coagulopathy, defined by prolonged coagulation parameters (e.g. international normalized ratio, prothrombin time) or thrombocytopenia (Table 3). Rhabdomyolysis, characterized by elevated creatine phosphokinase (CPK) levels exceeding 1000 units/L, was observed in 8 (12%) patients. Acute kidney injury occurred in 6% of patients, and haematologic abnormalities included leucocytosis (36%) and anaemia (20%).

Medical interventions and disposition

Antivenom

Sixty-five (94%) patients received the equine polyvalent snake antivenom, which is manufactured in Saudi Arabia and contains F(ab')₂ fragment antibodies (Table 4). The mean dose was 14 vials; 61% received the initial 5-vial dose, 39% required additional doses, the highest being 110 vials. The most common reasons for antivenom re-administration were progressive swelling, suggesting compartment syndrome (22%) and coagulopathy (9%). Reaction to antivenom occurred in 6 (9%) patients, which included mild and non-life-threatening reactions such as itching, skin rash and shortness of breath, and these responded to salbutamol nebulization and steroid.

Anticholinesterase medication

Three patients received anticholinesterase medication for suspected neurogenic envenomation (Table 4). One patient who received physostigmine experienced bradycardia and was treated with atropine. First patient was 57-year-old woman who had respiratory arrest upon arrival to the emergency room after cobra bite. After 24 hours of bite, the brain stem functions became absent

and the neurotoxic snakebite mimicking brain death was the provisional diagnosis. She received 3 doses of intravenous neostigmine 3 mg over 5 minutes along with an intravenous dose of atropine 0.5 mg, after which her pupils showed slight reaction to the light. Along with neostigmine doses, she received pyridostigmine 60 mg via a nasogastric tube, every 6 hours for 24 hours. The second patient was a 30-year-old male who had been bitten by a black snake (unknown species) and arrived at the emergency room in ventricular fibrillation cardiac

Table 3 Laboratory findings in patients with snake envenomation, Saudi Arabia, January 2000 to December 2021

Laboratory findings	Frequency (%)
International normalized ratio, median 1.1 (range 1.0–1.6)	
Prothrombin time, median 13 (range 12–20.5)	
Activated partial thromboplastin time, median 32 (range 28.6–42.5)	
Platelet, median 258 (range 179.5–338)	
Creatinine, Median 0.74 (range 0.5–0.99)	
Acute kidney injury – creatinine > 1.4mg/dl	4 (5.8)
Creatine phosphokinase, median 510 (range 167–747)	
Rhabdomyolysis – creatine phosphokinase > 1000 unit/L, median 3074.6 (range 1843.5–3415.5)	
Rhabdomyolysis – creatine phosphokinase > 1000 unit/L	8 (11.6)
Haemoglobin, median 13.7 (range 11.25–15.5)	
Haemoglobin level	
High	2 (2.9)
Low	14 (20.3)
Normal	53 (76.8)
White blood cell, median 9 (range 7–12.5)	
Leucocytosis	25 (36.2)
Potassium, median 3.9 (range 3.6–4.1)	
Sodium, median 137 (range 135–140)	

Table 4 Medical interventions for snakebite patients, Saudi Arabia, January 2000 to December 2021

Medical intervention	Frequency No. (%)
Antivenom administration	65 (94.2)
Antivenom dose, mean 14 (range 5–12.25)	
Neurological manifestations, mean 22.25 (range 8.75–31.5)	
Haematological manifestations, mean 19 (range 5–25)	
Compartment suspicious, mean 15 (range 5.5–12)	
Re-administration of antivenom	
No. of re-administrations	27 (39.1)
Swelling/compartment	15 (21.7)
Coagulopathy	6 (8.7)
Neurogenic	3 (4.3)
Other	3 (4.3)
Not applicable	11 (15.9)
Reaction to antivenom	
Managed antivenom reaction	6 (8.7)
Reaction severity	
None	62 (89.9)
Mild	5 (7.2)
Severe	1 (1.4)
Fasciotomy	11 (15.9)
Anti-cholinesterase	3 (4.3)
Anti-cholinesterase side effects	1 (1.4)
Prior atropine	2 (2.9)
Blood products	23 (33.3)
Opioid for pain management	9 (13.0)
Tetanus	7 (10.1)
Steroid	12 (17.4)
Antibiotics	46 (66.7)
Disposition	
Discharged against medical advice	6 (8.8)
Fatality	3 (4.5)
Discharged	57 (82.9)
Left against medical advice	3 (3.8)
Length of hospital stay, mean 3 (range 1–6.5)	
Neurogenic complication, mean 6 (range 1.5–7.5)	
Hematologic complication, mean 7 (range 3–7)	
Suspected compartment complication, mean 15 (range 6–22)	

arrest. He received 2 mg of intravenous physostigmine and 10 vials of anti-snake antivenom bolus with no clinical effect and declared dead after 35 mins. Third patient was a 33-year-old male who arrived at the emergency room in asystole cardiac arrest after cobra bite. After return of spontaneous circulation, he received intravenous neostigmine infusion, which triggered bradycardia and was stopped. The patient was declared dead after 24 hours.

Fasciotomy

Eleven patients underwent fasciotomy to address suspected compartment syndrome (Table 4).

Other interventions

Twenty-three (33%) patients received blood products: packed red blood cells (7 patients), fresh frozen plasma (15 patients), platelets (4 patients), vitamin K (13 patients), and cryoprecipitate (1 patient). Nine patients (13%) received opioid analgesics, 46 (67%) received antibiotics, 7 (10%) received tetanus toxoid, and 12 (17%) received steroid injections.

Outcomes

Fifty-one (74%) patients were admitted to the hospital, 6 (9%) were discharged from the emergency department and 9 (13%) left against medical advice. The median length of stay was 4 days; 19 (23%) patients stayed for more than 5 days. Three patients (4.5%) died, all suspected to be secondary to neurogenic snakebite.

Reasons for prolonged hospitalization

The reasons for prolonged hospitalization were suspected compartment syndrome (mean length of stay 15 days), haematologic abnormalities (mean length of stay 7 days) and neurologic abnormalities (mean length of stay 6 days).

Discussion

This study provides valuable insights into the clinical presentations, management and outcomes of snakebite cases in Asir Province of southern Saudi Arabia. It highlights the significant presence of neurogenic envenomation, with approximately 19% of patients experiencing neurologic manifestations that ranged from ptosis and diplopia to respiratory failure and cardiac arrest. This highlights the need for clinicians in the region to be familiar with the spectrum of snakebite presentations and the importance of prompt diagnosis and treatment, particularly for neurotoxic envenomation.

As reported in previous studies, males were more commonly affected and most snakebites occurred during summer (June–August) (13,14). The diverse neurogenic manifestations observed in this study highlight the importance of considering envenomation by various snake species in Asir Province beyond the commonly implicated cobra. Although cobra bites were the most frequent cause of neurotoxicity in our cases, one patient with *Echis coloratus* envenomation presented with ophthalmoplegia and proximal weakness, suggesting the potential for neurogenic effects from other viperid species. This finding underscores the need for further research on the venom profiles of regional snakes and their specific neurotoxic components.

The high proportion of patients with concurrent coagulopathy (43%) further complicates the clinical outlook of neurogenic snakebite in this region. This observation suggests synergistic effects between different venom components, highlighting the need for a

holistic approach to managing neurotoxic envenomation. Despite aggressive management, including antivenom, anticholinesterases for cobra bite cases, and supportive care, 3 patients succumbed to envenomation. This highlights the potential seriousness of neurogenic snakebite and the necessity for additional research to enhance management and patient outcomes. Further studies are required to elucidate the specific venom components responsible for neurotoxicity in regional snakes, develop more targeted antivenom therapies and refine clinical management protocols.

A review of existing literature on neurogenic snakebites in Saudi Arabia revealed limited data. One study reported a single case of bulbar palsy following cobra envenomation (13). Two case reports described neurotoxic features after snakebite, including one mimicking brain death and another presenting with vegetative state and intracranial haemorrhage (15,16). Our case series significantly expands existing literature on neurogenic snakebite in the region and highlights the diverse presentations and potential severity of this condition. Three patients with suspected neurogenic envenomation received anticholinesterases, which aligns with the WHO guidelines recommending anticholinesterase administration for such cases, especially those involving cobra bites (17). The proteomics studies on *Naja* species revealed the dominance of 3-finger toxins, which bind human post-synaptic nicotinic acetylcholine receptors and are responsible for neurotoxic symptoms (18). Anticholinesterases act by inhibiting the enzymes responsible for acetylcholine breakdown, leading to increased acetylcholine levels in the synaptic cleft and potentially reversing neurogenic manifestations (19,20).

Our study identified venom-induced consumptive coagulopathy (VICC) in approximately 46% of patients. VICC, a frequent complication of snakebite envenoming, is often associated with specific toxins in the venom, such as snake venom metalloproteinases (SVMPs) and cysteine protease toxins (CTLs) (11). While coagulopathy was present in many of our patients, active bleeding manifested in only 6% of cases. This discrepancy suggests that coagulopathy, despite its high prevalence, may not always translate to overt bleeding in snakebite patients. However, it remains a significant complication, sometimes necessitating the re-administration of antivenom and contributing to prolonged hospitalization (mean length of stay 7 days). This finding deviates from previous studies, such as Malik et al, who reported active bleeding in 18% of their patients with coagulopathy. Further investigation is needed to understand the factors influencing this variation in bleeding risk among patients with VICC (8).

The relatively high use of blood products (33% of patients) in our study, compared to other reports, such as Malik et al (8), where only 9.5% of patients received blood products, warrants further investigation. This discrepancy could be attributed to differences in the

severity of coagulopathy within our cohort, variations in transfusion protocols across regions, or the specific snake species responsible for envenomation. Notably, the study conducted in Riyadh by Al-Durhim et al (16) reported a higher prevalence of coagulopathy (66.7%) but a lower use of blood products (9.5%), suggesting potential differences in management practices depending on the predominant snake species in each region.

Snake venom harbours a complex mixture of toxins that can cause local clinical manifestations by disrupting various tissues. Two key venom components involved in this process are snake venom metalloproteases (SVMPs) and myotoxic phospholipases A2 (PLA2s) (21-23). Detailed analysis (proteomics or transcriptomics data) for medically important snake species in the Asir Province, including *Echis coloratus*, *Cerastes cerastes*, *Bitis arietans*, and *Echis pyramidum*, reveals that SVMPs are the most abundant toxins, with an average relative abundance of 41.9% (24-26). In the absence of a standardized WHO system based solely on local manifestations, we used a general clinical snakebite severity scoring system to guide the management of patients who presented primarily with local and systematic signs (Table 5).

Table 5 Clinical guidance for classifying snakebite envenomation severity

Dry bites	No venom is injected into the victim. No systemic symptoms or local signs develop beyond the puncture wound itself.
Minimal envenomation	Local reactions are characterized by localised findings at the bite site, typically including bruising, tenderness and minimal swelling. These reactions typically do not cause systemic symptoms or abnormalities in laboratory tests.
Mild envenomation	Similar to local reactions, extensive local reactions lack systemic symptoms and abnormal laboratory findings. However, the local effects are more pronounced, with tissue damage extending several centimetres from the bite site, potentially reaching a major joint like the ankle or wrist.
Moderate envenomation	Mild systemic reactions may present with non-life-threatening symptoms, such as nausea, vomiting, or mild coagulopathy without causing bleeding. Local tissue damage can extend beyond the involvement of 2 adjacent joints.
Severe envenomation	Severe systemic reactions are characterized by a combination of 2 factors: extensive local damage and significant systemic toxicity. Locally, tissue damage can extend beyond the involvement of 2 adjacent joints. Systemically, these reactions can cause life-threatening complications like low blood pressure (hypotension), swelling that affects the airway, or muscle paralysis.

Compartment syndrome, a potentially severe complication, was suspected in 14 (20%) patients based on clinical signs such as pain on passive stretch and tense compartments during examination. Fasciotomy, a surgical procedure to relieve pressure buildup, was necessary in 11 (79%) of 14 of these cases based on clinical assessment and intraoperative findings. Notably, no amputations were required in our study, despite a high fasciotomy rate. This finding contrasts another study from Riyadh, where 19% of patients with suspected compartment syndrome required fasciotomy and one patient underwent amputation (16). This difference may be attributed to earlier recognition and intervention in our cohort or the snake species involved, as *Cerastes cerastes* were more prevalent in the Riyadh study.

Rhabdomyolysis is a devastating complication of snakebites, due to the destructive action of PLA₂s present in the venom (27). It was identified by elevated CPK levels >1000 U/L (28). In our study, it presented in approximately 12% of patients and did not appear to be a significant risk factor for acute kidney injury (AKI). Notably, the single patient who developed AKI associated with rhabdomyolysis had pre-existing chronic kidney disease, suggesting that rhabdomyolysis alone may not be sufficient to trigger AKI in this population. Further investigation with larger sample sizes is needed to definitively establish the association between rhabdomyolysis and AKI in snakebite cases.

The manufacturer (National Antivenom and Vaccine Production Centre) recommends an initial dose of 4–6 vials of polyvalent snake antivenom, with potential for repeat administration based on clinical response (29). Our study observed a significantly higher mean antivenom dose of 22 vials in neurologic envenoming cases. This finding underscores the critical importance of early and sufficient antivenom administration tailored to the specific venom profile and clinical severity of each case. Notably, the mean antivenom dose varied depending on the presenting complication: 19 vials for reversing haematological complications and 15 vials for treating suspected compartment syndrome.

We observed a re-administration rate of up to 39%, highlighting the potential need for continuous antivenom therapy to achieve optimal clinical response. Allergic reactions to antivenom were generally mild and transient, affecting only 9% of our patients. One patient required cessation of antivenom and corticosteroid administration because of shortness of breath and pruritus. This relatively low rate of severe allergic reactions is encouraging for the continued use of antivenom as the cornerstone of snakebite treatment.

Our study population exhibited a higher use rate of blood products (30%) and antibiotics (67%) than some previous reports. This could be due to variations in regional snake species, differences in clinical management protocols, or the specific features of our cohort.

Despite the routine use of paracetamol, opioid analgesics were administered to only 13% of patients, compared to 34% in another study (8). This discrepancy may reflect an underestimation of pain severity or concerns about potential opioid side effects in this population.

Approximately 28% of patients required hospitalization beyond 5 days. The primary factors contributing to prolonged hospitalization were coagulopathy, fasciotomy procedures, and AKI, highlighting the importance of vigilant monitoring and management of these complications in snakebite patients.

To the best of our knowledge, this is the first study to comprehensively describe neurogenic snakebite manifestations in multiple patients in Saudi Arabia. This detailed characterisation of clinical presentations, which includes diverse neurologic features, serves as a valuable resource for physicians who manage these complex and potentially life-threatening cases. Our study provides insights into antivenom dosage, safety and effectiveness in the context of neurogenic, coagulopathy and suspicious compartment syndrome presentations, informing evidence-based treatment strategies.

Although this retrospective study offers valuable insights, it has some limitations. The design potentially introduces selection bias and limits control for confounding factors. The sample size is modest considering the 21-year timeframe. This can be because the study focused on data collected at the 4 major referral centres in Asir Province. While these centres handle a significant portion of snakebite cases, milder envenomation cases may have been treated at peripheral healthcare facilities, potentially underrepresenting such cases in our data. Complete medical records with the necessary details (demographics, clinical presentation, envenomation details, outcomes) for a retrospective study like ours may not be available for all cases treated over the entire 21-year period and data collection limitations can limit sample size in retrospective studies. The study is geographically limited to the Asir Province, potentially affecting generalisability to areas with different snake species and envenomation profiles. Despite the challenges in definitively identifying snake species most times, we effectively managed cases of neurotoxic envenomation by relying on clinical features and patient descriptions.

Conclusion

The diverse snake species in Asir Province of Saudi Arabia pose a significant public health threat, capable of causing a spectrum of clinical manifestations ranging from mild local envenomation to life-threatening complications like coagulopathy, compartment syndrome, respiratory paralysis, and even cardiopulmonary arrest. While antivenom, in addition to supportive care, remains the cornerstone of therapy, our study highlights the need for a comprehensive and multifaceted approach to

snakebite management, with appropriate dosing tailored to the severity and specific clinical features of each case. The high prevalence of coagulopathy and other major complications underscores the importance of

vigilant monitoring, prompt recognition, and aggressive interventions to optimize patient outcomes.

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Présentation clinique, résultats et prise en charge des cas de morsures de serpent en Arabie saoudite

Résumé

Contexte : L'envenimation par morsure de serpent constitue un important problème de santé publique dans la province d'Asir en Arabie saoudite.

Objectif : Caractériser les espèces de serpents et la présentation clinique ainsi que les résultats et la prise en charge des cas de morsures de serpent hospitalisés dans quatre grands hôpitaux de ladite province.

Méthodes : La présente étude rétrospective a examiné les dossiers médicaux de cas de morsures de serpent chez des enfants et des adultes hospitalisés dans quatre hôpitaux régionaux d'Arabie saoudite entre janvier 2000 et décembre 2021. Les données ont été collectées à partir des termes de recherche « morsure de serpent », « cobra », « sérum antivénimeux polyvalent », « antivenin », « syndrome de loge » et « fasciotomie » et analysées à l'aide du logiciel R version 4.2.

Résultats : Soixante-neuf patients ont été identifiés, dont 30 (43,5 %) étaient des enfants âgés de moins de 18 ans. Des manifestations locales ou systémiques sévères sont survenues chez 33 patients (47,8 %), tandis qu'un syndrome de loge a été suspecté chez 14 patients (20,3 %), nécessitant une fasciotomie dans 11 cas (15,9 %). Les manifestations systémiques comprenaient une neurotoxicité (13 patients ; 18,8 %), une coagulopathie (31 patients ; 44,9 %), une rhabdomyolyse avec une créatine phosphokinase supérieure à 1000 U/L (huit patients ; 11,6 %) et des lésions rénales aiguës (quatre patients ; 5,8 %), dont deux ont évolué vers des néphropathies terminales. Trois patients (4,5 %) sont décédés. Une majorité (94 %) ont reçu une dose initiale de sérum antivénimeux polyvalent de cinq flacons, avec 39 % nécessitant des doses supplémentaires. Les effets indésirables liés à l'antivenin ont été légers et transitoires chez six patients (9 %). Des produits sanguins et des antibiotiques ont été utilisés dans 30 % et 67 % des cas, respectivement. Un traitement par anticholinestérasiques a été administré à trois patients (4,3 %).

Conclusion : Les morsures de serpent constituent un important problème de santé publique dans la province d'Asir en Arabie saoudite. L'antivenin, en complément des soins de soutien, demeure le traitement de base. Cependant, pour optimiser les résultats pour les patients, notre étude souligne la nécessité d'une approche plus globale de la prise en charge, comprenant une surveillance attentive avec une reconnaissance et des interventions rapides.

المظاهر السريرية لحالات لدغ الثعابين ومخارجها وعلاجها في المملكة العربية السعودية

موسى سليمان الفيفي، بدر آل يحيى، أثير عيد العتيبي، حمدان مشاري الأكلبي، إبراهيم الهلالي، إبراهيم آل بن حسان، علي عبيد البشاببي، هادي عيسى العلي، حسن م. الزهراني، نادية م عواجي، سامي الشهري، علي يحيى دربي، محمد س. القحطاني، تيم باتريك موران، برنت دبليو مورغان

الخلاصة

الخلفية: لا يزال التسمم بلدغ الثعابين يُشكل قلقاً صحياً عاماً كبيراً في محافظة عسير بالمملكة العربية السعودية.

الأهداف: هدفت هذه الدراسة الى توصيف أنواع الثعابين والمظاهر السريرية لحالات لدغ الثعابين التي أُدخلت إلى 4 مستشفيات رئيسية في المحافظة، ومخارج هذه الحالات وعلاجها.

طرق البحث: استعرضت هذه الدراسة الاستعدادية السجلات الطبية لحالات لدغ الثعابين لدى الأطفال والبالغين الذين أُدخلوا إلى 4 مستشفيات إقليمية في المملكة العربية السعودية في الفترة بين يناير/ كانون الثاني 2000 وديسمبر/ كانون الأول 2021 باستخدام المصطلحات البحثية "لدغ الثعابين" و"الكوبرا" و"مُضاد الرُغاف متعدد التكافؤ" و"مُضاد السَّم" و"متلازمة الحيز" و"بُضع اللفافة". وخضعت البيانات للتحليل باستخدام الإصدار 4.2 من برنامج R.

النتائج: جرى تحديد تسعة وستين مريضاً، منهم 30 طفلاً (43.5%) تقل أعمارهم عن 18 عاماً. وظهرت مظاهر موضعية أو جهازية وخيمة على 33 مريضاً (47.8%)، في حين اشتبه في إصابة 14 مريضاً (20.3%) بمتلازمة الحيز، وهو ما تطلب إجراء بُضع اللفافة لما مجموعه 11 مريضاً (15.9%). وشملت المظاهر الجهازية السمية العصبية (13 مريضاً؛ 18.8%)، والاعتلال الخثري (31 مريضاً؛ 44.9%)، وانحلال الرُبيدات حيث تجاوزت نسبة فسفوكيناز الكرياتين 1000 وحدة/ لتر (8 مرضى؛ 11.6%)، والإصابة الكلوية الحادة (4 مرضى؛ 5.8%)، ووصلت حالة

مريضين منها إلى الفشل الكلوي في مرحله النهائية. وتوفي ثلاثة مرضى (4.5%). وحصلت غالبية النساء (94%) على جرعة أولية من مُضاد السَّمَم تألفت من 5 قنينات، واحتاجت 39% منهن إلى جرعات إضافية. وكانت التفاعلات الضارة المرتبطة بمضاد السَّمَم خفيفة وسريعة الزوال لدى 6 مرضى (9%). واستُخدمت منتجات الدم في علاج 30% من الحالات والمضادات الحيوية في علاج 67% من الحالات. وحصل 3 مرضى (4.3%) على العلاج بمضاد الكولينستراز.

الاستنتاجات: يُشكّل لدغ الثعابين تهديداً صحياً عاماً كبيراً في محافظة عسير بالمملكة العربية السعودية. ولا يزال مضاد السَّمَم العنصر الأساسي للعلاج إلى جانب الرعاية الداعمة، غير أن دراستنا تسلط الضوء على ضرورة اتباع نهج أكثر شمولاً في التدبير العلاجي، فضلاً عن الرصد اليقظ للحالات والتعرف الفوري عليها وتنفيذ التدخلات، بهدف تحسين الحصائل الصحية للمرضى.

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