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Venomous Snakebites in Children in Southeast Turkey

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Abstract

Objective: Due to the hot climate of the Southeastern Anatolia Region, snake poisoning is common, which causes serious mortality and morbidity. We aimed to present the clinical course, complications and treatment approaches of patients hospitalized with snakebites.

Methods: One-hundred and eight pediatric patients treated in the hospital for snakebites, excluding dry bite, were included in the study during a 5-year period. Gender, age, bite site, month, time, type of intervention in the field, symptoms, laboratory findings, complications, tetanus vaccination and antivenom administration were recorded by reviewing patient files.

Results: The patients were aged between 10.2+3 (2-15) years and 72 (66.7%) were males. Seventy-three (67.6%) of patients were from rural areas. The bites were mostly from the lower extremity, at between 12-18 o'clock. Grade 1 patients were excluded from the study. At the time of admission, there were 47 (43%) grade 2 and 31 (28%) grade 3 patients. It was observed that with increased grade, higher levels of white blood cell count, glucose level and hospital stay were seen ($p<0.01$), and the grade increased as the hospital admission time increased (p:0.024). A negative correlation was found between the length of hospital stay and the platelet level (p=0.016). The most common complications were tissue necrosis (13%) and compartment syndrome (9.2%). There was a positive correlation between grade and compartment syndrome (P=0.001). Antivenom was administered to 80 (74%) of patients.

Conclusion: Patients with snakebite poisoning should be transferred to the nearest emergency room quickly so that the management can be carried out in a timely manner. The signs of poisoning can affect not only the bitten area, but also all systems, causing multi-organ failure and even death. Therefore, patients should be frequently evaluated in terms of systemic findings. The efficacy of treatment is enhanced by aggressive supportive care and rapid administration of appropriate neutralizing antivenom.

Key words: Child, snakebites, poisoning, treatment

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Türkiye'nin Güneydoğusundaki Çocuklarda Zehirli Yılan Isırıkları

Öz

Amaç: Güneydoğu Anadolu Bölgesi sıcak iklimi nedeniyle, ciddi mortalite ve morbiditeye neden olan yılan zehirlenmelerinin sık görülür. Bu araştırmada, yılan ısırığı ile yatırılan hastaların klinik seyir, komplikasyon ve tedavi yaklaşımlarını sunmayı amaçlandık.

Yöntemler: 5 yıllık dönemde yatırılarak tedavi edilen zehirli yılan ısırığı tanılı 108 çocuk olgu, çalışma kapsamına alındı. Cinsiyet, yaş, yılan ısırmasının meydana geldiği olay yeri, saati, mevsimi, semptomlar, gelişen klinik tablolar, laboratuvar bulgular, ilk müdahale süresi ve şekli, toksik etkiler ve komplikasyonlar, spesifik tedavi yaklaşımları, semptom ve komplikasyonların tedavi yaklaşımları, tetanoz immünizasyonu dosya taraması yapılarak kaydedildi.

Bulgular: Yaşları 10,2+3 (2-15) yıl arasında değişen hastaların 72 (%66,7)'si erkekti. Hastaların 73(%67,6) 'ü kırsal kesimindendi. Isırılmalar sıklıkla alt ekstremiteden, 12:00-18:00 saatleri arasında olmuştu. Kırk yedisi (%43)'si grade 2, 31 (%28)'i grade 3 ile başvurdu. Grade arttıkça beyaz küre sayısı, glukoz düzeyi ve hastanede kalma süresinin arttığı (p<0,01), hastaneye başvuru süresi uzadıkça da grade'in arttığı (p:0,024) belirlendi. Hastanede kalma süresi ile trombosit düzeyi arasında negatif korelasyon bulundu (p=0,016). En çok gelişen komplikasyon doku nekrozu (%13) ve kompartman sendromu (%9,2) idi. Grade ile kompartman sendromu arasında pozitif korelasyon olduğu görüldü (P=0,001). Antivenom 80 (%74) hastaya uygulandı.

Sonuç: Yılan ısırığı zehirlenmesi olan hastanın yönetiminin zamanında yapılabilmesi için hızlıca en yakın acil servise transferi yapılmalıdır. Zehirlenme bulguları sadece ısırılan bölgeyi değil, tüm sistemleri etkileyerek çoklu organ yetmezliğine hatta ölüme neden olabilir. Bu nedenle hastalar sık sık sistemik bulgular açısından da değerlendirilmelidir. Tedavinin etkinliği, agresif destekleyici bakım ve uygun nötralize edici antivenomun hızlı uygulanmasıyla artırılır.

Anahtar kelimeler: çocuk, yılan ısırıkları, zehirlenme, tedavi.

INTRODUCTION

Poisoning as a result of snakebites is common in many parts of the world, especially in rural areas and in summer. Snakebite was recognized as an underestimated tropical disease by the World Health Organization (WHO) in 2009. According to WHO, more than 5 million snakebites occur worldwide each year, resulting in approximately 2.5 million intoxications and 81,000 to 138,000 deaths[1].

The Viperidae (viper) family is responsible for almost all of the snakebite cases in our country[2]. Viperidae mostly causes hematotoxic effects, as well as local poisoning findings that cause necrosis in the skin and deep structures[2]. Snakebite affects many systems simultaneously and is among the poisonings with high mortality. In this study, we aimed to present the toxic effects, clinical course, complications and treatment approaches in patients admitted to our emergency department with a snakebite.

METHODS

The files of the patients who were admitted to the pediatric emergency department of Dicle University Faculty of Medicine with snakebite and were hospitalized in the pediatric intensive care and pediatric service were reviewed retrospectively after the approval of the ethics committee no. 537 on 26.04.2012. Between 2006 and 2011, 108 pediatric patients with venomous snakebite were included in the study. Patients with proposed dry bite in their records were not included in the study. Gender, age, localization, time, season, symptoms, clinical pictures, laboratory findings, first response time and type, toxic effects and complications, specific treatment approaches, treatment approaches of symptoms, complications and tetanus immunization were recorded by file screening.

Three criteria were defined to determine the development of a snakebite-induced poisoning: observation of the snakebite by the patient or

the parent, local findings and hematological findings (Table I). It was accepted as intoxicated, in cases where two of these three criteria were matched. Initial evaluation was made in all cases in the pediatric emergency service and routine blood samples were taken. Grading was done according to local signs and systemic symptoms[3]. Grade 0 may have minimal pain without symptoms. Grade 1 has minimal symptoms and non-progressive local pain and swelling. In Grade 2, there is Moderate symptom and locally progressive pain, swelling or ecchymosis. In Grade 3, severe systemic findings are accompanied by severe local findings and significant laboratory abnormalities. The patients who were evaluated as grade 1-2 were monitored and transported to the pediatric service after ensuring vascular access and providing hemodynamic support, while patients evaluated as grade 3 were taken to the pediatric intensive care unit. After consultation with the orthopedic clinic, a half plaster splint was performed to some of them if necessary, and fasciotomy was performed for those who were thought to have compartment syndrome. The indication for fasciotomy was based on clinical observation and physical examination (increasing swelling and pain in the involved extremities, severe pain on passive muscle stretch tests). Antivenom treatment was applied to cases with grade 2 and 3, and it was repeated for those with an increasing grade. Tetanus toxoid was administered to 84 patients whose wounds were cleaned without debridement and who did not bring their vaccination schedule. Applied fluid-electrolyte support, erythrocyte, thrombocyte suspension, fresh frozen plasma, inotrope, corticosteroid and heparin were recorded.

Table I: Local and hematological findings in snake poisoning

Local Findings	**Hematological Findings**
Edema	Neutrophilia
Hyperemia	Leukocytosis
Ecchymosis	Low hemoglobin
Find	LDH increase
Diameter difference	INR increase
Necrosis	Thrombocytopenia

Data analysis was performed in IBM SPSS Statistics 17.0 (IBM Corporation, Armonk, NY, USA) package program. The significance of the difference between the groups in terms of continuous numerical variables in which parametric test statistics assumptions were met was evaluated with Student's t test, while the significance of the difference in terms of continuous numerical variables in which parametric test statistics assumptions were not met was evaluated with Mann Whitney U test. Categorical variables were analyzed with the Chi-Square test and the results were considered statistically significant for $p < 0.05$

RESULTS

The ages of the patients ranged from 2 to 15 years, with a mean age of 10.2± 3.08 years. Seventy-two (66.7%) of the patients were male. Seventy-three (67.6%) of all our cases were from the rural areas of the provinces. Most of the bites were observed to have occurred between May and June (n=47). While the time to reach the nearest health facility after the bite is unknown, the mean time to apply to our hospital was 5.1±8.06 hours. It was observed that bites have happened mostly between 12 and 18 o'clock in the majority of cases (52.8%) and mostly from the lower extremity (69.4%). The general and epidemiological characteristics of the patients are summarized in Table II.

Table II: General and Epidemiological Features of the Cases

Gender	**Values**
Male	72 (66.7%)
Female	36 (33.3%)
City of origin	
Diyarbakır	60 (55.6%)
Mardin	17 (15.7%)
Şırnak	13 (12%)
Batman	8 (7.4%)
Siirt	6 (5.6%)
Şanlıurfa	3 (2.8%)
Muş	1 (0.9%)
Residential area	
Town center	35 (32.4%)
Rural area	73 (67.6%)
Months	
May June	47 (43.7%)
July August	30 (27.8%)
September October	23 (21.3%)
November-March	5 (4.6%)
Hour	
06:00-12:00	26 (24.1%)
12:00-18:00	57 (52.8%)
18:00-24:00	21 (19.4%)
24:00-06:00	4 (3.7%)
Bitten place	
Lower extremity	74 (68.5%)
Upper extremity	33 (30.5%)
Other regions (Back)	1 (0.9%)

Tourniquet has been applied to the proximal part of the bitten area in 10 of the patients, razor-wing was applied to 9 and suction was applied to 3 before the admission, while ice has not been applied to any patient. Local findings frequently seen at the time of presentation were pain, redness and edema in the same extremity. Systemic symptoms such as fever, abdominal pain, hypotension, blurred consciousness, and respiratory distress were present. The clinical features observed at the time of admission are summarized in Table III.

Table III: Clinical Characteristics of the Cases at the Time of Admission

Local Findings	**Values**
Ache	108 (100%)
Rash	102(94.4%)
Edema	67 (62%)
Ecchymosis	39 (36.1%)
Necrosis	17 (15.7%)
Bulla	4 (3.7%)

Even at Grade 0, the patients with a history of snakebite were kept under observation in the emergency department for 24 hours and examined hourly. Thirty of the patients were grade 1, 47 were grade 2, 31 were grade 3. Grade 1 patients were hospitalized for an average of 4.53±2.38 days, grade 2 patients for 6.95±3.07 days, and grade 3 patients for 9.70±3.76 days. It was determined that as the grade increased, white blood cell count, glucose level and hospital stay time increased ($p<0.01$, correlation coefficient 39%, 27.9%, 53.3%, respectively). There was no statistically significant correlation between the time of admission to our hospital and grade ($p=0.015$, correlation coefficient 20.8%). Laboratory parameters at the time of admission to the hospital are summarized in Table IV.

Table IV: Laboratory Parameters at the Arrival of Patients

Laboratory Parameters at the Arrival of Patients	Mean±SS (Min-Max)	Reference Values
White blood cell count (/mm^3)	15200±6937 (4500-31100)	4600-10200
Hemoglobin value (g/dL)	13.2±2.0 (4.2-18.2)	12.2-18.1
Hematocrit value (%)	38.5±5.7 (11.1-49.8)	33.7-53.7
Platelet count (/mm^3)	274644±94030	142000-424000
Neutrophil (null)	13339±11238 (2600-31800)	2000-6900
LDH (U/L)	330.7±148.6(170-948)	92-232
Glucose (mg/dL)	133.2±60.5 (78-450)	0-175
INR (U/Ml)	1.1±0.7 (0.8-2.3)	0.88-1.2

LDH: Lactate dehydrogenase, INR: International Normalized Ratio

Compartment syndrome was the most common complication during treatment with a rate of 9.2%. Three of the patients came from the external center with fasciotomy due to compartment syndrome, and 7 of them underwent fasciotomy due to compartment syndrome after consultation with orthopedics in our clinic. In one of the hospitalized patients, necrosis occurred in the second finger of the right hand, and the finger was amputated. Complications that developed during treatment are summarized in Table V. A significant correlation was found between grade and compartment syndrome ($p<0.001$). There was no statistical difference between compartment syndrome and age and platelet count ($p> 0.01$).

Table V: Complications During Treatment

Complication	Values
Compartment syndrome	10 (9.2%)
Hematological complication	8 (7.4%)
Hepatic complication	7 (6.4%)
Neurological complication	2 (1.9%)
Cardiovascular complications	2 (1.9%)
Dysseminated Intravascular Coagulopathy	1 (0.9%)
Organ necrosis	1 (0.9%)

Hematological complications developed in 8 of the cases during the treatment. Erythrocyte transfusion was applied to 4 cases. Two patients were given erythrocyte suspension twice, 8 patients were given fresh frozen plasma, and 1 patient was given erythrocyte suspension, thrombocyte suspension and fresh frozen plasma. While the time to reach the nearest health facility is unknown, the mean time to reach our hospital was 5.15±8.06 hours. Grade did not change with increased duration of admission to the hospital ($p=0.015$, correlation coefficient 20.8%). The hospital stay was 7.07 3.6 days. The mean platelet value of our patients were 274644± 94030 (43000-488000) u/L. A negative correlation was found between the length of stay in the hospital and the platelet level ($p=0.016$). A statistically significant correlation was found between grade and length of hospital stay. It was determined that the duration of hospital stay increased with increasing grade ($p<0.1$).

Tetanus toxoid was administered to 84 (77.7%), antibiotic to 89 (82.4%), analgesia to 93 (86.1%), corticosteroid to 63 (58.3%), heparin to 2, antihistamine to 62 (57.4%) and antivenom to 80 (74.07%) patients. Side effects did not develop in any of those treated with antivenom serum. Half plaster splint was applied to 16 (14.8%) patients during follow-up period. One patient has died due to multi-organ failure, a 4-year-old female patient with profound anemia, disseminated intravascular coagulation (DIC), severe respiratory distress, who was taken to the intensive care unit, intubated and connected to a mechanical ventilator, followed for 7 days.

DISCUSSION

Snakebites are most commonly seen in the prepubertal period of childhood. Biting occurs less frequently in the 0-5 age group (preschool)[4]. In our study, the mean age was 10.2± 3.08 (2-15) years. Özay et al. 58.5% of the cases were reported to be male[3]. In our study,

66.7% of the cases were male. Boys are more likely to be exposed to snakebites because they go out more, work in the field and interfere more with the places where the snakes live. In a study in which 82 pediatric poisoning cases were evaluated, 2 of the cases were due to snakebites[5].

When snakebites are examined in terms of the bitten area, it has been emphasized in the literature that the lower extremities (53-85%) are bitten more frequently[6-8]. In our study, lower extremity bites (69.4%) were also common. We think that foot bites are more common due to carelessness while walking. It was observed that biting was most common between 12 and 6 pm with a frequency of 57 (52.8%) cases. The reason for the increased frequency in the afternoon and evening hours is thought to be due to the warm weather in our region and correspondence to snakes' hunting hours. These data are compatible with the literature[7,9].

When examined in terms of seasonality, it was seen that biting cases mostly admit in summer and autumn months. In our study, 43.7% of the cases were bitten in May-June, 27.8% in July-August, 21.3% in September-October and 4.6% in November-March. In warm seasons, children go out and play outside more often and are taken to the field by their families, increasing biting incidents. Rural areas are environments where snakes are frequently found and cases of biting mostly come from these regions. In their study, Plowman et al. reported the time to hospital admission to be 68 minutes after a snake bite in the USA[10]. While 73 of our cases (67.6%) were from the rural areas of the surrounding provinces, the time to reach the nearest health institution after being bitten was not known clearly, while the time to apply to our hospital was 5.15±8.06 hours. We conclude that the transportation time to the hospital is prolonged due to specific conditions of our region and waiting times in the rural areas.

Patients evaluated as grade 1-2 were monitored and taken to the pediatric service, while grade 3 patients were taken to the pediatric intensive care unit. Patients with grade 0 were discharged after 24 hours of observation and were not included in the study. In our study, 30 (27.7%) of the cases were grade 1, 47 (43.5%) were grade 2, and 31 (28.7%) were grade 3. Grade 1 patients were hospitalized for 4.53 ± 2.38 days, grade 2 patients for 6.95 ± 3.07 days, and grade 3 patients for 9.70 ± 3.76 days.

In the setting of first aid in snakebites, the patient should firstly be reassured, his or her discomfort should be reduced, his or her jewelry should be removed, the wound surface should be wiped without tampering with the wound site, and measures should be taken to slow down the entry of the venom into the central circulation. The bitten limb should be immobilized and splinted. First aid applications that will cause harm should be avoided, and techniques such as incisions and mouth sucking should never be applied to the wound site. Tight tourniquets attached to the upper level of the bitten area not only aggravate the local tissue findings of snake venom, but also increase the risk of secondary compartment development due to tissue hypoxia and edema due to the interruption of arterial circulation for a long time[11-13].

No proven effect has been shown for treatments such as cutting, suction, tourniquet application, heat, cold or electrical application in the field as a first aid. In fact, it is much more likely to cause additional tissue damage and delay definitive treatment. It is not recommended because the flora in the mouth will further contaminate the wound, if it is mandatory, the absorption process can only be done with special instruments[14]. Abubakar SB. et al. evaluated 16 patients with venomous snake bites in whom incisions have been done in the field and emphasized that although treatment was given, gangrene developed in 15 patients, necrosis in 4

patients, and compartment syndrome in 3 patients[15]. In our study, a tourniquet was applied to proximal parts of bitten areas in 10 of the patients before admission, razor-wing in 9 and suction in 3 patients. In one of our patients, the second finger of the right hand was amputated because of necrosis.

Ozay et al. reported pain in 100% of the cases, edema in 93.5%, and ecchymosis in 46.8%[16]. Chippaux et al. reported in their study edema in 93.7% of patients and hemorrhage in 48.9%, with clotting times more than 30 minutes in 65.4% of the patients[17]. We observed systemic symptoms such as fever in 12 (11.1%), abdominal pain in 5, hypotension in 3, blurred consciousness in 2 cases, and respiratory distress in 2 cases.

Leukocytosis with predominant peripheral neutrophilia, which indicates the inflammatory response, confirms that the patient is affected systemically[18]. The mean white blood cell count of our patients was 15200 ± 6937 (4500-31100) /mm3 and the mean platelet value was 274644 ± 94030 (43000-488000) u/L. We found that the duration of hospital stay increased in cases with low platelet count. Therefore, cases with low platelet count at the first admission should be followed up more carefully.

In the study conducted by Kim YH et al. with 158 snakebite cases, 10.8% of the patients needed fasciotomy due to compartment syndrome[19]. In our study, the most common complication developed during treatment was compartment syndrome with a frequency of 9.2%. Three of our cases came from an external center with fasciotomy due to compartment syndrome, and 7 of them underwent fasciotomy due to compartment syndrome after consultation with orthopedics in our clinic. The indication for fasciotomy was made based on clinical observation and physical examination (increasing swelling and pain in the involved extremities, severe pain on passive muscle stretching tests), and intracompartmental pressure measurement could not be performed in any of the cases. A significant correlation was found between grade and compartment syndrome and length of hospital stay ($p<0.001$). There was no statistical difference between compartment syndrome and age and platelet count (p value> 0.01).

Bawaskar et al. reported 11% mortality in their study[20]. Boyer et al. reported recurrent, persistent or late coagulopathy 2-14 days after poisoning in 53% of the cases[21]. In our cases, heparin was given to 2 cases with deep vein thrombosis. In the study conducted by Özay et al. 13% of the cases had organ necrosis, 9.1% had compartment syndrome, 9.1% had DIC, 5.2% had neurological complications, 6.3% had hematological complications, and 3.9% of patients had died[3]. In our study, hematological complications developed in 8 of the cases. Erythrocyte transfusion was applied to 4 cases. Two patients were given erythrocyte suspension twice. Fresh frozen plasma was given to 8 cases, erythrocyte suspension, thrombocyte suspension and fresh frozen plasma were given to 1 case. Hepatic complications developed in 6.4%, neurological complications in 1.9%, cardiovascular complications in 1.9%, DIC in 1 patient, and organ necrosis in 1 patient.

Snakebite should be considered as a wound prone to tetanus formation and the patient should be vaccinated if necessary by taking the vaccination schedule into account. The use of empirical antibiotics is no longer recommended to prevent secondary bacterial infections[22]. In our study, each patient was graded, and patients who were accepted as grade 1 were not given empirical antibiotics, rather they were given to high-grade patients who had been treated with faulty first aid interventions such as suctioning and incision. Antibiotics were given to 89 (82.4%) patients. In the study of Ibister GK et al. with 195 snake poisoning patients, hematotoxicity was found in 74%, systemic

disorders in 12%, neurotoxicity in 5% and myotoxicity in 4% of patients, and they used an average of 4 vials (low dose) of antivenom[23]. Seifert et al. stated in their study that some effects of the poison could be reversed by antivenom and severe thrombocytopenia was improved[24]. In our study, patients with dry bite were excluded from the study and antivenom was administered to 80 (74%) patients. Side effects did not develop in any of those treated with antivenom serum.

CONCLUSION

Patients with snakebite poisoning should be transferred to the nearest emergency room quickly so that the management can be carried out in a timely manner. Poisoning can affect not only the bitten area, but also all systems, causing multi-organ failure and even death. Therefore, patients should be frequently evaluated in terms of systemic findings. The efficacy of treatment is enhanced by aggressive supportive care and rapid administration of appropriate neutralizing antivenom.

Ethics Committee Approval: The files of the patients who were admitted to the pediatric emergency department of Dicle University Faculty of Medicine with snakebite and were hospitalized in the pediatric intensive care and pediatric service were reviewed retrospectively after the approval of the ethics committee no. 537 on 26.04.2012.

Declaration of Conflicting Interests: The authors declare that they have no conflict of interest.

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