Short Survey

Snakebite Management Knowledge and Predictive Factors among Emergency Residents in Malaysia

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ABSTRACT

OBJECTIVE: To evaluate the extent of knowledge among emergency residents (ERs) regarding the identification of common local venomous snakes and the management of snakebites and to identify predictive factors influencing the adequacy of this knowledge.

METHODOLOGY: This study conducted a self-developed, questionnaire-based, anonymous, and self-administered cross-sectional survey from March to June 2018 at two major urban hospitals in Malaysia's Klang Valley region: the Emergency Department (ED) of University Malaya Medical Centre (UMMC) and the ED of Hospital Tengku Ampuan Rahimah (HTAR). A structured questionnaire covering demographic information, snakebite recognition, and management was distributed to ERs. We employed a non-probability, purposive universal sampling method. We randomly selected samples from a list provided by the person in charge.

RESULTS: Only 16.3% demonstrated adequate knowledge in this domain. Univariate logistic regression analysis indicated a significant association between age and knowledge adequacy ($p<0.05$) and a marginal association between knowledge adequacy and gender ($p=0.046$) or prior snakebite training ($p=0.05$). Subsequent backward stepwise logistic regression analysis identified age as the sole significant independent predictor, accounting for gender, work experience, position, training received, and management experience ($p=0.012$; OR 1.33, 95% CI 1.07-1.67).

CONCLUSION: the study revealed a deficiency in knowledge regarding snakebite recognition and management among emergency residents. Advanced age is a predictor of knowledge adequacy in snakebite management. Therefore, implementing an improved educational program targeting healthcare professionals across all levels and categories is a viable and practical solution.

KEYWORDS: emergency residents, knowledge adequacy, predictive factors

INTRODUCTION

Snakebite is a significant global health issue affecting many tropical and subtropical countries, resulting in preventable morbidity and mortality[1]. It is often referred to as "the poor man's disease" because it disproportionately affects low-income populations in rural areas, such as farmers, plantation workers, and outdoor labourers. The World Health Organization (WHO) has classified snakebite envenoming as a "neglected tropical disease" due to the insufficient attention it has received from national and international health authorities[2]. Accurate global statistics on snakebite incidence, morbidity, and mortality are lacking, with many cases going unreported, especially in rural areas where traditional healers are often consulted for treatment, and hospital records remain incomplete[3].

According to WHO estimates, there are approximately 1.8 million venomous snakebites worldwide each year, leading to 20,000-90,000 deaths[1,4]. Southeast Asia, South Asia, and sub-Saharan Africa bear the highest burden of snakebite, particularly in rural regions, where morbidity and mortality rates are elevated[4]. In Malaysia, between 2010 and 2014, the Ministry of Health reported 15,798 snakebite cases, with 16 fatalities, indicating an average of 3 to 4 deaths annually. States with high agricultural activity, like Kedah and Perak, reported the highest cases[5].

The awareness of proper snakebite treatment is increasing among victims, likely leading to a rise in reported cases[6]. However, inadequate access to healthcare services and a shortage of safe and effective antivenin contribute to the elevated morbidity and mortality associated with snakebites[7].

Snakebites constitute a medical emergency; untreated or poorly treated bites can result in prolonged or permanent disability[8]. Some studies have revealed that healthcare professionals (HCPs) providing essential snakebite treatment can be ineffective[9-11]. Successful snakebite treatment primarily relies on the

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availability of antivenin, resuscitation medications, a sound understanding of snakebite assessment, and trained personnel[12,13]. Inadequate knowledge of snakebite management can lead to delayed antivenin administration, increasing the risk of morbidity and mortality associated with snakebite envenomation.

Unfortunately, multiple studies have indicated that knowledge regarding snakebite management among HCPs, even in countries where snakebites are common like Malaysia, remains deficient, despite continuous medical education programs and the availability of local and international protocols and guidelines for snakebite management[14,15,16,17,18].

This study aimed to assess the knowledge of snakebite management among Malaysian emergency residents (ERs) and identify the factors influencing their knowledge, including their ability to identify local venomous snakes based on morphology, fang marks, and toxidrome, as well as their proficiency in first aid management and antivenin administration. No studies have been done to assess the knowledge of snakebite management among emergency residents in Malaysian hospitals. The study hypothesized that ERs have inadequate knowledge of snake identification and snakebite treatment. The findings from this study could serve as a benchmark for the Malaysian health authorities and medical educators to improve and expand training on snakebite management.

METHODOLOGY

Study design

This study conducted a self-developed, questionnaire-based, anonymous, and self-administered cross-sectional survey from March to June 2018 at two major urban hospitals: the Emergency Department (ED) of University Malaya Medical Centre (UMMC) and the ED of Hospital Tengku Ampuan Rahimah (HTAR).

UMMC is a tertiary teaching hospital in Kuala Lumpur, serving a population of approximately 4.5 million in the Klang Valley. HTAR is a tertiary public hospital in Klang District, Selangor, with a busy ED, seeing 500 to 600 patients daily, totalling 220,000 annually.

Randomization method

We employed a non-probability, purposive universal sampling method. We randomly selected samples from a list provided by the person in charge. ERs who met the inclusion criteria and agreed to participate were included, while those on leave or working part-time were excluded.

Sample size calculation

We initially estimated that there were approximately 200 ERs across both hospitals. With a 95% confidence level and a 5% confidence interval, we determined the sample size to be 132. We factored in a 20% dropout rate for this study, resulting in a total sample size of 158 respondents. All registered ERs, including emergency physicians, emergency master trainees, resident medical officers, and house officers, were invited to participate, except for Emergency Physicians (EPs), who reviewed and validated the questionnaires.

Methods

Before constructing the questionnaires, we conducted an extensive literature review and consulted local guidelines, including the latest Malaysia Clinical Practice Guidelines (CPG) on snakebite management. The questionnaire we developed consisted of two main sections: demographics data and a knowledge assessment section. The demographic variables include age, gender, educational background, current post, hospital of practice, years of experience in the emergency department, sources of knowledge on snakebite management, attended courses, and experience managing snakebite cases. The knowledge assessment section was divided into three subsections. There were five questions on snake species identification, ten on snakebite management, and five on antivenin. There was a total of 20 questionnaires. To answer these questionnaires, we use the yes and no method. Each emergency resident who had consented to participate in the study answered the paper-based questionnaires. A panel of experts validated the questionnaire. The facial validity index and Cronbach alpha of the questionnaires were 84.1% and 0.78, respectively.

Ethical approval was obtained from the Medical Research Ethics Committee at the University Malaya Medical Centre in 2019. The survey ensured anonymity and confidentiality for participants, and informed consent was obtained.

Statistical analysis

Data from the questionnaires were analyzed using Statistical Package for the Social Sciences (SPSS) version 23.0. Descriptive statistics were used to present frequencies, percentages, means, and standard deviations. The study referred to previous research to determine knowledge adequacy, considering a total score of 80% or higher as adequate knowledge. Logistic regression analyses were conducted to estimate odds ratios (ORs) and 95% confidence intervals (CI) for factors affecting knowledge adequacy. A P-value less than 0.05 was considered statistically significant.

RESULTS

Demographic Profile

Our objective was to obtain data from 158 individuals, with a 95% confidence interval and an alpha precision of 0.05. Regrettably, we could only receive responses from 86 emergency room (ER) participants, yielding a response rate of 68.6%. The majority of respondents were from the UMMC.

The respondents' ages ranged from 28 to 33 years, with a median age of 30. The majority were female gender (60.5%). About 42.0% of the ER respondents were postgraduate emergency medicine trainees (master EM). Over half (52.3%) had less than four years of working experience, and the majority (66.3%) had not attended formal lectures, seminars, or

courses related to snakebite management. Most respondents (72.1%) had experience in managing snakebite cases. Two-thirds of the respondents (66.3%) declared they had never attended any formal lecture, seminars or courses related to snakebite management. The informal sources of knowledge were received from their senior colleagues (27.8%) or from their initiatives like reading and watching YouTube. **Table I**

ERs Knowledge About Snakebite Management

The mean score for correct answers in the knowledge assessment was 12.51 out of 20 (62.5%), below the threshold for adequate knowledge. Only 16.3% of respondents achieved adequate snakebite recognition and management scores.

In the knowledge assessment, 59.3% of respondents had difficulty identifying common local poisonous snakes based on clinical presentation, while 91.9% recognized the importance of accurate snake species identification. Regarding envenomation symptoms and signs, 63.9% of respondents had poor knowledge. 76.7% of respondents acknowledged antivenin's importance, but only 40.7% had adequate knowledge of antivenin and its side effects. **Table II, III, IV and V**.

Predictor Factors

Univariate logistic regression showed significant associations between knowledge adequacy and age, years of working experience, and training received. However, multivariate analysis did not find significant associations between these variables. **Table VI**.

Table I: Respondents' demographic data

Factors	Characteristic	n (%)	Median (IQR)
Gender	Male	34(39.5)	
	Female	52(60.5)	
Age			30 (28, 33)
Working experience (years)	<4	45(52.3)	
	³4	41(47.7)	
Position	House officer	22(25.6)	
	Medical Officer	19(22.1)	
	EM Trainee	36(41.9)	
	Specialist/Consultant	9(10.5)	
Place of practice	UMMC	59(68.6)	
	HTAR	27(31.4)	
*Sources of knowledge	Medical Textbook	51(20.8)	
	Articles/journal	17(6.9)	
	CPG	46(18.8)	
	Courses/workshop	31(12.7)	
	Colleague/Senior	68(27.8)	
	Self-interest	13 (5.3)	
	YouTube /Internet	18 (7.3)	
	Others (medical school)	1 (0.4)	
Training received (attended course)	No	57(66.3)	
	Yes	29(33.7)	
Management experience	No	24(27.9)	
	Yes	62(72.1)	

**One respondent can have more than one source of knowledge; thus, the total number of sources of knowledge is higher*

Table II: Snakebite identification and related clinical features

Knowledge assessment	Correct n (%)	Wrong n (%)
Identification of specific types of snake is important in snakebite management	79(91.8)	7(8.1)
A presence of a bite mark with two puncture wounds is a sign of a venomous snakebite	61(70.9)	25(29.1)
Naja & king cobra species fall into the Elapidae family	52(60.5)	34(39.5)
Pit viper envenomation includes coagulopathy and muscle paralysis	21(24.4)	65(75.6)
Naja sumatrana is capable of spitting its venom into human eyes	56(65.1)	30(34.9)

Table III: Snakebite envenomation

Knowledge assessment	Correct n (%)	Wrong n (%)
Symptoms of envenomation		
Manifestations of cobra or krait envenomation include muscle paresis and respiratory failure.	72 (83.7)	14 (16.3)
Krait and sea snake bites have minimal or absent local signs of inflammation	36 (41.9)	50 (58.1)
Ptosis is an early sign of muscle paralysis.	66 (76.7)	20 (23.3)
Manifestations of sea snake envenomation include rhabdomyolysis and renal failure	59 (68.6)	27 (31.4)
Pit viper venom induces consumptive coagulopathy.	69 (80.2)	17 (19.8)

Table IV: Snake bite management

Knowledge assessment	Correct n (%)	Wrong n (%)
Management of snake bite		
Application of a tourniquet is a recommended technique to reduce systemic envenomation.	66(76.6)	20(23.3)
Pressure bandage immobilization is contraindicated in cobras and pit viper bites	21(24.4)	65(75.6)
The result of a 20-minute whole blood clot test (WBCT) determines the type of antivenin	24(27.9)	62(72.1)
The rate of proximal progression (RPP) of local tissue edema is a more beneficial indicator to start antivenin compared to circumferential measurement	60(69.8)	26(30.2)
Prophylactic hydrocortisone and antihistamines are indicated for all snakebite cases	62(72.1)	24(27.9)

Table V: Antivenin and side effects

Knowledge assessment	Correct n (%)	Wrong n (%)
Intravenous infusion (IV) is the only route of administration	76(88.4)	10(21.6)
Antivenin is a 'gold standard' treatment	66(76.7)	20(23.3)
Intramuscular (IM) Adrenaline is the initial treatment of severe antivenin anaphylaxis	62(72.1)	24(27.9)
During anaphylaxis, withhold IV antivenin, treat the anaphylaxis and continue once the anaphylaxis is resolved	49(57.0)	37(43.0)
Coral snake bite antivenin is available in Malaysia	19(22.1)	67(77.9)

DISCUSSION

Recognizing and managing snakebites in an emergency setting is paramount in ensuring effective snakebite management and preventing complications related to snake envenomation. In simpler terms, snakebite victims require immediate attention from adequately trained medical personnel[7,17]. The emergency department is a critical safety net for patients with acute illnesses, including snakebites or unidentified bites, who cannot receive emergency care elsewhere. ERs play a vital role as frontline providers in snakebite management.

This study is the first in Malaysia to assess ERs knowledge of snakebite management in two urban hospitals. We could not find any other studies that evaluated the competency of urban doctors in snakebite management. Among the respondents, over 50% were senior residents, either EM trainees (41.9%) or Emergency Physicians (EPs) (10.5%).

Despite their status as experienced residents, they had limited experience managing snakebites. This study revealed that ER's knowledge adequacy was suboptimal. The mean overall knowledge score per respondent was 12.5 out of 20, or 62.5%, falling below the recommended passing mark of 16 out of 20, or 80%. Only 16.3% of ERs who responded to the survey had adequate knowledge of snakebite management. In comparison, only 45.4% of healthcare providers in Savannakhet Province Laos hospitals had sufficient knowledge of snakebite management[15].

Recognizing snake species is crucial because it enables clinicians to anticipate complications and select the appropriate antivenin, thereby avoiding the unnecessary expense and potential adverse reactions associated with incorrect treatment[9]. While 91.8% of the respondents acknowledged the importance of accurately identifying the specific snake species in snakebite management, only about 70% knew that fang marks indicate a venomous snake bite. Furthermore, only around 60% were familiar with the classification of venomous snake families. ERs appeared to have better knowledge of Elapidae species such as the king cobra and Naja, for several reasons, including their prevalence in Malaysia and their distinctive characteristics.

Only 41.9% of respondents correctly answered that local signs are minimal or absent after krait bites. This misconception is a significant safety concern, as healthcare professionals may prematurely discharge patients who could later develop myotoxic or neurotoxic complications.

Regarding snake types and envenomation manifestations, over 80% of respondents were well-informed about systemic envenomation caused by Elapidae or Viperidae species. However, a simplified understanding acquired during undergraduate years, such as pit viper envenomation being hemotoxic, cobra envenomation being neurotoxic, and sea snake

Table VI: Factors associated with knowledge adequacy in snakebite management

Factor	Adequate n (%) 14 (16.3)	Inadequate n (%) 72 (83.7)	Univariate			Multivariate		
			Unadjusted OR	95% CI	p-value	Adjusted OR	95% CI	p-value
Age	-	-	1.34	1.07-1.68	0.011	1.36	0.93-2.0	0.115
Gender								
Male	9 (26.5)	25 (73.5)	3.38	1.02-11.19	0.046	2.54	0.71-9.12	0.154
Female	5 (9.6)	47 (90.4)						
Working experience								
<4 years	4 (8.9)	41 (91.1)	3.31	0.95-11.54	0.061	2.53	0.29-22.11	0.401
>4 years	10 (24.4)	31 (75.6)						
Position								
House officer	1 (4.5)	21 (95.5)	0.09	0.08-1.09	0.06	-	-	-
Medical Officer	1 (5.3)	18 (94.7)	0.11	0.01-1.28	0.08	-	-	-
Master Student	9 (25)	27 (75)	0.67	0.14-3.23	0.62	-	-	-
Specialist/Consultant	3 (33.3)	6 (66.7)				-	-	-
Training received								
No	6 (10.5)	51 (89.5)	0.31	0.95-0.99	0.05	1.81	0.47-6.89	0.388
Yes	8 (27.6)	21 (72.4)						

envenomation being myotoxic and neurotoxic, influenced their responses. This simplicity led to misconceptions, such as the failure to recognize that pit viper envenomation can manifest with hematotoxicity and neurotoxicity effects or that sea snake envenomation includes rhabdomyolysis and renal failure.

Immediate transportation of snakebite victims to a healthcare facility with well-trained professionals and access to antivenin is crucial and should precede first aid treatment[15]. Surprisingly, about 23% of respondents recommended using a tourniquet for systemic snakebite envenomation. Other ineffective and potentially harmful methods were still being practised, such as consuming chillies, burning the wound, making incisions, attempting to suck out the venom, or applying topical concoctions. Approximately 75% of respondents incorrectly believed that pressure bandage immobilization is not contraindicated in cobras and pit viper bites, which could worsen local envenomation effects.

Antivenin is a cornerstone of snakebite treatment for both local and systemic envenomation. Timely administration of antivenin can accelerate recovery and reduce long-term deficits, even though intravenous deposition of venom, anaphylaxis, nonimmune anaphylactic reactions, and systemic toxicity can lead to fatalities. Delayed identification and antivenin treatment contribute to higher morbidity and mortality rates in snakebite cases, possibly exacerbated by the relatively low prevalence of snakebite in urban hospitals[20].

In our study, 88.4% of respondents correctly identified intravenous infusion as the sole route for antivenin administration. The reasons for incorrect responses were either ignorance, as 66.3% of respondents had not received any training, or a lack of practical experience, as 27.9% had never encountered snakebite cases. However, these findings were consistent with studies conducted in India and Laos[15,21].

Respondents generally recognized anaphylactic shock as a severe adverse effect of antivenin and knew its initial management involved adrenaline (epinephrine). However, 57% of them indicated that they would continue antivenin administration despite severe anaphylaxis, which could endanger the patient's condition.

Regarding knowledge sources, approximately 27.8% of participants relied on colleagues and seniors for information. However, the adequacy of this knowledge, obtained through clinical observations, may vary and may not reflect best practices or updated information[17,18]. Medical textbooks were the second most common source of information (20.8%). Other formal sources included clinical practice guidelines (18.8%) and workshops (12.7%). Local clinical guidelines and workshops were considered more reliable than medical textbooks, as they felt the local incidence distribution and types of snakes might differ from Western textbooks[13].

Regarding potential predictors influencing respondents' competency, univariate logistic regression analysis showed a significant association between age and knowledge adequacy ($p<0.05$), with marginal associations between knowledge adequacy and gender ($p=0.046$) or receiving snakebite training ($p=0.05$). However, after adjusting odds ratios using a multivariate model and conducting bivariate correlation analysis, age remained the only significant independent predictor, correlating with gender, years of experience, position, training received, and management experience ($p=0.012$; OR 1.33, 95% CI 1.07-1.67). Advanced age was positively correlated with increasing expertise, seniority, training, and management experience.

In summary, there is clear evidence that ERs in these two urban hospitals lack the necessary knowledge for identifying venomous snakes and managing snakebites. These findings align with results from previous studies[14,15,21]. Relevant and authoritative bodies must be established to oversee on-site training, ensuring consistency and relevance. These efforts should involve ERs and other healthcare providers.

Understanding local venomous snake species, snakebite first aid procedures, and the risks and benefits of antivenin administration is essential for providing optimal care to victims and counselling their caregivers and families on prevention measures. The current curriculum for snakebite education in medical schools should be revisited, whether at the undergraduate or postgraduate level. For instance, snakebite management topics should be integrated into relevant departments like Emergency Medicine. Additionally, simplified and standardized local protocols and guidelines for managing snakebites in the emergency department should be developed. The recent publication of the Malaysian Clinical Practice Guidelines (CPG) for snakebite management is a positive step toward achieving standardized protocols.

In Malaysia, a small group of Emergency Physicians interested in clinical toxicology has existed since early 2012. They developed Remote Envenomation Consultation Services (RECS), a 24-hour voluntary on -call consultation service. The primary goal of RECS is to improve patient outcomes for snakebite victims by optimizing and advocating appropriate treatment modalities at every level of patient management. Consultations are conducted via telephone calls, email, and various forms of short text messaging, including Facebook and WhatsApp.

However, this study has several limitations. Firstly, being voluntary, it struggled to attract a substantial number of respondents, resulting in an inadequate sample size. Secondly, the study was confined to two healthcare centres in the Klang Valley and may not fully represent all ERs in Malaysia, particularly those in rural areas. We recommend conducting a follow-up multicentre study involving all healthcare professionals

and implementing educational interventions in the future. This approach would provide a more comprehensive understanding of the current issues and improve the efficiency of snakebite management.

CONCLUSION

The knowledge of snakebite recognition and management among ERs is deficient and falls short of ensuring optimal care for snakebite patients. Advanced age is the independent predictor of knowledge adequacy in snakebite management. Therefore, implementing a more robust educational program for healthcare professionals at all levels and categories is a practical and effective solution.

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AUTHOR CONTRIBUTION

Rahim MKA: Conceived and designed the study, wrote and revised the manuscript critically for important intellectual content.
Nor ATM: Performed experiments / collected data / analyzed data
Nazri MZAM: Performed experiments / collected data / analyzed data
Bustam A: Conceived and designed the study.
Ahmad R: Conceived and designed the study and revised the manuscript critically for important intellectual content.
All authors read and approved the final manuscript.

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