

# VENOMOUS SNAKE BITES IN LAO PDR: A RETROSPECTIVE STUDY OF 21 SNAKEBITE VICTIMS IN A PROVINCIAL HOSPITAL

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**Abstract.** This is a retrospective case series report of 21 snakebite victims admitted to a provincial hospital 80 km north of the capital city Vientiane between January 2007 and June 2008. There were 13 Malayan Pit Viper (MPV) and 6 Green Pit Viper (GPV) bites. Two patients could not identify the snake, but developed severe coagulopathy and were therefore most likely bitten by a MPV or GPV. Seven of 13 patients bitten by the MPV and 3 of 6 patients with GPV bites developed a coagulopathy; 2 patients bitten by a MPV had severe local signs of envenomation. The supply of antivenom was limited, thus only 6 patients received this treatment, although it was indicated in 12. The treatment was effective and the INR was normal or less than 3 within 24 hours. No early side effects occurred after injection of monospecific antivenom obtained from the Thai Red Cross. Antivenom is not available in most hospitals of the country and the majority of snakebite victims are still treated by traditional healers in the villages. Training of medical doctors and health workers in the management of snakebites is urgently needed to improve the outcome of this neglected disease in Lao PDR.

**Key words:** snake bites, Malayan Pit Viper, Green Pit Viper, Lao PDR

## INTRODUCTION

The incidence of snakebite is high in countries with a tropical climate and where agricultural activities are the main source of income. Both conditions apply to the Lao PDR, a landlocked country between China, Vietnam, Cambodia and Thailand with about 6 million inhabitants. In a review of the epidemiology of snakebites the incidence in Asia was estimated at 114 per 100,000 inhabitants, with about 57 envenomations per 100,000 and a mor-

tality rate of 3 per 100,000 (Chippaux, 1998). This is a very rough estimate since epidemiological data from most parts of the region are very limited. At least 9-12 venomous and potentially life-threatening snake species are found in Lao PDR: the Malayan Pit Viper (*Calloselasma rhodostoma*), the Green Pit Vipers (genus *Trimeresurus* with at least 3-5 species: *Trimeresurus albolabris*, *Tr. macrops*, *Tr. popeiorum*, *Tr. gumbrechtii* and *Tr. vogeli*), the Mountain Pit Viper (*Ovophis monticola*), the Malayan and Banded Kraits (*B. candidus* and *Bungarus fasciatus*), the common cobras (genus *Naja* with at least two species: *Naja kaouthia* and *N. siamensis*) and the King Cobra (*Ophiophagus hannah*) (Deuve, 1970; Teynié

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and David, 2007; Stuart and Heatwole, 2008). The Thai Red Cross produces horse-derived monospecific antivenom against seven venomous snake species. This antivenom is not available in most hospitals in the Lao PDR and medical doctors have little knowledge about the specific treatment for poisonous snakebite. Death after snakebite in this region occurs either from bleeding caused by Malayan Pit Viper and Green Pit Viper venom or from muscle paralysis with respiratory failure caused by the venoms of kraits and cobras (Looareesuwan *et al*, 1988). Local envenoming, especially after bites from the Malayan Pit Viper and cobras may cause chronic ulceration and finally severe physical disability (Warrell, 1999). Only professional medical care, including the use of antivenom by trained doctors, can substantially reduce morbidity and mortality.

This retrospective study provides data about the frequency, severity and kinds of snakebite encountered in a provincial hospital of Vientiane Province, the Lao PDR. So far there is no data available about venomous snakebites in this country.

#### MATERIALS AND METHODS

This was a retrospective case series study of 21 snakebite victims admitted to the provincial hospital in Ban Phonemy, Vientiane Province between January 2007 and June 2008. The hospital is located about 80 km north of the capital city Vientiane. All files of patients with snakebite admitted to the hospital during this 18 month time period were reviewed for gender, age, date and time of the snake bite, local and systemic symptoms and for prothrombin time (PT) and thrombocyte levels. The results of the PT were documented in seconds and as INR ratios. A

PT greater than 120 seconds was considered as severe coagulopathy.

Monospecific antivenom from the Thai Red Cross against Malayan Pit Viper venom was given to patients with coagulopathy per the guidelines for the clinical management of snakebites in the South-East Asia Region from the World Health Organization (Warrell, 1999). Unfortunately antivenom was not available for all patients in whom it was indicated.

#### RESULTS

Twenty-one patients were admitted between January 2007 and June 2008 to the provincial hospital of Vientiane Province after a snakebite. According to the information given by the patient or their relatives, there were 13 Malayan Pit Viper bites and 6 Green Pit Viper bites. Two patients could not identify the snake, but developed severe coagulopathy.

In 2 cases the dead snake was brought to the hospital. One was identified as a Malayan Pit Viper (*Calloselasma rhodostoma*) and the other as a Large-eyed Green Pit Viper (*Tr. macrops*). In the 13 patients bitten by a Malayan Pit Viper (MPV) 7 were male and 6 female; their ages ranged from 13 to 75 years, with a mean of 37 years. Two had severe local swelling of more than 50% of the extremity with blisters and necrosis, three had moderate swelling of less than 50% of the extremity without necrosis and 8 had only minor swelling of less than 10 cm around the bite or no local signs (Table 1).

Seven patients in the MPV group developed severe coagulopathy with a PT > 120 seconds within 48 hours of the bite. Five had systemic signs of bleeding from the bite site, gum bleeding, macrohematuria, vaginal and/or gastrointestinal bleeding. Thrombocytopenia (< 140.000/ $\mu$ l) occurred

Table 1  
Symptoms and characteristics of 21 snakebite victims in Lao PDR.

	MPV	GPV	Unknown snake
No. of cases	13	6	2
Male/female	7/6	4/2	2/0
Age (years)	13 - 75 (mean 37)	13 - 54 (mean 28)	28 - 40
Local signs <sup>a</sup> (severe/moderate/minor)	2/3/8	0/4/2	0/1/1
Prolonged PT	7	3	2
Systemic bleeding	5	0	1
Thrombocytopenia	3 <sup>b</sup>	1	0
Bite site (foot/hand/head)	12/1/0	4/1/1	2/0/0
Bite time <sup>c</sup> (day/night)	5/3	5/1	0/2
Seasonal distribution dry season/rainy season	7/6	0/6	0/2

<sup>a</sup>Severe local signs = swelling of > 50% of the limb with necrosis; moderate local signs = swelling < 50% of the limb without necrosis; minor local signs = swelling <10 cm around the bite site.

<sup>b</sup>3 cases of thrombocytopenia out of 10 cases with available results.

<sup>c</sup>Data on bite time was available in 16 cases

MPV, Malayan Pit Viper; GPV, Green Pit Viper

in 3 of 10 patients, where the thrombocyte count was available. They also had a PT > 120 seconds. Two of these 7 patients with severe coagulopathy had severe local signs of envenoming, 2 had moderate and 3 minor swelling around the bite site. In the latter 3 patients with minor local signs, 2 also had systemic signs of bleeding. Twelve patients were bitten in the foot or lower part of the leg and one in the hand.

Five MPV bite patients received monospecific antivenom against MPV venom. One patient received 10 ml (1 vial), 3 patients received 20 ml (2 vials) and 1 patient received 30 ml (3 vials). After 24 hours the INR was normal in 4 patients and improved to INR = 2.8 in one patient. Further PT were not done and reoccurrence of coagulopathy cannot be excluded. No early side effects occurred after injection of antivenom.

Six patients identified the snake as a Green Pit Viper. There were 4 males and 2 females and their ages ranged from 13 to

54 years, mean 28. Four patients had moderate local signs with swelling of less than 50% of the bitten limb and 2 had only minor swelling around the bite site. Two patients had severe coagulopathy (PT > 120 seconds) and one had a mild coagulopathy (PT 14 seconds, INR 1.5). No patients had systemic signs of bleeding. One of these 6 patients had a mild thrombocytopenia of 96,000/ $\mu$ l and a PT > 120 seconds. In four cases the bite was on the foot, in 1 case it was on the face and in 1 case it was on the hand.

Green Pit Viper antivenom was not available, although administration was indicated for 2 patients with severe coagulopathy.

Two male patients were bitten at night and could not identify the snake. Both had severe coagulopathy with PT > 120 seconds. One had systemic signs of bleeding with hematuria, gum bleeding and bleeding from cuts at the bite site performed by a doctor in a district hospital. In both cases



Fig 1—An incision at the bite site after a Malayan Pit Viper bite caused continuous and significant bleeding in a patient with a severe coagulopathy. Layman and medical doctors in the study region still perform this harmful first aid procedure.

the bite site was on the foot.

The patient with signs of systemic bleeding received 30 ml of monospecific Malayan Pit Viper antivenom. A significant improvement in the coagulopathy was observed, and by 21 hours after antivenom injection the INR was 3.0. Bleeding from the cuts at the bite site, from the bladder and gums had stopped 8 hours after injection. There were no early side effects due to antivenom administration. The second patient received no antivenom and the INR was normal only after 7 days. The INRs of the two patients bitten by Malayan Pit Vipers, for whom antivenom was not available, became normal by 8 and 10 days after their bites. One had systemic bleeding requiring transfusion of 9 units of blood.

Three patients presented with continuous bleeding from cuts at the bite site, performed by doctors at district hospitals. This harmful first aid is still widely used in the region (Fig 1). None of the patients

had applied a tourniquet before arriving at the hospital.

Nineteen snakebites occurred between March and September. March and April are the last months of the dry season and May to September is the rainy season. There were only 2 snakebites between October and February. Ten victims were bitten during the daytime and 6 at night. In 5 cases the time of the bite was not documented (Table 1).

## DISCUSSION

There are at least 9-12 venomous snakes of medical importance in the Lao PDR (Deuve, 1970; Teynié and David, 2007; Stuart and Heatwole, 2008). The venom of these snakes is potentially life threatening. Monospecific antivenom against these snake species is available at the Thai Red Cross. There is monospecific antivenom against the Malayan Pit Viper (*Calloselasma rhodostoma*), the Green Pit Viper (*Tr. albolabris*), the common cobra (*Naja kaouthia*), the King Cobra (*Ophiophagus hannah*), the Malayan Krait (*Bungarus candidus*) and the Banded Krait (*Bungarus fasciatus*). Species-specific antivenom against *Tr. albolabris* is also effective against *Tr. macrops* and *Tr. popeiorum* venom. Antivenom against *Naja kaouthia* possesses neutralizing capacity against the venom of *Naja siamensis* (Khow *et al*, 1997; Chanhome *et al*, 2002).

Twenty-one patients with snakebites admitted to a provincial hospital in Vientiane Province between January 2007 and June 2008 were reviewed in this retrospective case series. Malayan Pit Vipers and Green Pit Vipers were the predominant snake species responsible for envenomations in this region. Thirteen cases were Malayan Pit Viper bites, 6 were Green Pit Viper bites and 2 were unknown.

The latter 2 patients developed severe coagulopathies, which can be caused either by a MPV or GPV, the only hematotoxic snakes in the study region. The rapid improvement in PT after injection of 30 ml of MPV antivenin in one of the patients is reliable proof he was bitten by a MPV. Other venomous snakes causing coagulopathy in Southeast Asia, such as the Russell's Viper, have never been found in Lao PDR. *Deinagkistrodon acutus* may only be found in the northern mountainous regions close to the Chinese and Vietnamese borders (Deuve, 1970).

There were no bites by Malayan or Banded Kraits, common cobras or the King Cobra during the study period, although these snakes are found in this region. Epidemiological studies from Thailand show a similar distribution with almost 70% of snakebites in the country being caused by Malayan and Green Pit Vipers, followed by the common and spitting cobras (17%), the Russell's Viper (14%) and the Kraits (1%) (Viravan *et al*, 1992). Kraits are nocturnal snakes and very sluggish during the daytime and therefore bites are very rare in this region.

The snake species were identified by description and information given by the victim or the relatives and only in two cases was a dead snake brought in and identified as a Malayan Pit Viper (*Calloselasma rhodostoma*) and a Large-eyed Green Pit Viper (*Tr. macrops*). Snake identification by layman may be incorrect. However only two hematotoxic snakes are found in the region, the Malayan Pit Viper and the Green Pit Viper, and these snakes are easy to distinguish by their different colors. Therefore, the identification of the snake given by the victim along with the clinical and/or laboratory signs of coagulopathy are fairly reliable. Immediate improvement in the prothrombin

time after injection with monospecific antivenom in 5 cases of Malayan Pit Viper bites is another strong indicator for correct identification. The Malayan Pit Viper has only one species, *Calloselasma rhodostoma*, but there are at least three medically important species of Green Pit Vipers: *Tr. albolabris*, *Tr. macrops* and *Tr. popeiorum*. More advanced knowledge is needed to differentiate them, but specific antivenom against *Tr. albolabris* is effective against all three species and for therapeutic purposes there is no need to differentiate them (Chanhome, 2002). Of 8 out of 9 patients in this study who did not develop a coagulopathy after a bite, identification may be incorrect in some cases, because there are non-venomous snakes in the region resembling the MPV and GPV on the first view (Viravan *et al*, 1992). One of these 9 patients brought the dead snake to the hospital and it was identified as *Tr. macrops*. However correct identification of the snake species is crucial, especially when monospecific antivenom is used for treatment. A rapid test to detect venom of the different medically important snakes in serum samples of the victim would be very helpful to guide specific treatment. Seven out of 13 patients in the Malayan Pit Viper bite group and 3 out of 6 in the Green Pit Viper group developed a coagulopathy. Similar results were found in a prospective study of 225 Malayan Pit Viper bites (Wongtongkam *et al*, 2005) and a study of 29 Green Pit Viper bites (Hutton *et al*, 1990), where 52.5% and 54%, respectively, developed significant coagulopathy.

Antivenom is not available in most hospitals in the Lao PDR and the supply is limited in the provincial hospitals of Vientiane Province. Although indicated in 12 patients with severe coagulopathy, antivenom was available for only six of them. The treatment was very effective al-

though only two patients got the recommended initial dose of 30 ml, but reoccurrence of coagulopathy cannot be excluded as further PT controls after specific treatment were not available.

There were no early reactions after antivenom injection, but information about late reactions was missing. A recent publication from Thailand showed the incidence of early reactions to the currently used monospecific horse-derived F(ab')<sub>2</sub> antivenom is low, at 3.5% with early reactions, including 1.2% with hypotension (Thiansookon and Rojnuckarin, 2008). Eighty-four percent of the patients in this trial received GPV antivenom and 13% Cobra antivenom. There were no anaphylactic reactions in the study of 225 MPV bites with 111 patients receiving MPV antivenom (Wongtongkam *et al*, 2005). In 1986 early reactions after injection of monospecific antivenom from the Thai Red Cross were reported in more than 80% of cases, and 10% had hypotension (Warrell *et al*, 1986). This striking improvement in antivenom quality can be confirmed in this study, although the number of patients was low. However, precautions against life-threatening anaphylactic reactions are required when using antivenom, especially the availability of adrenalin, a knowledge about the treatment of early reactions and good observation of the patient, especially during the first 3 hours after intravenous administration of antivenom, when early reactions will most likely occur.

Local signs of envenomation at the bite site were moderate or minor in most of the cases. Only two out of 13 patients after MPV bite had severe local reactions with tissue necrosis. This low incidence was also observed in 2 studies from Thailand where about 4% of patients (6 out of 145) and one out of 15 patients had severe

local reactions after the bite of a MPV (Warrell *et al*, 1986; Wongtongkam *et al*, 2005).

Local signs after MPV bites are not related to severity of the coagulopathy. Although the two MPV patients with tissue necrosis and blisters had a severe coagulopathy, coagulopathy cannot be excluded in patients with minor local signs of envenoming. Three patients in the present study with minor swelling at the bite site had laboratory evidence of a severe coagulopathy and 2 even had systemic signs of bleeding. Reid *et al* (1963) had different observations in his publication of 250 MPV bites which occurred mostly in northern Malaysia. He concluded absent or very light local swelling excludes serious poisoning. These findings were different from ours, although we had fewer cases; the difference may be due to geographic variability in venom composition which is observed in species belonging to the Viperidae and Elapidae families (Ferquel *et al*, 2007).

No fatal case occurred in the present study of 21 patients. With immediate, good medical care mortality due to Malayan and Green Pit Viper bites, attributable to hemorrhage or secondary infection of necrotic tissue is less than 1%. In a recent study of 225 Malayan Pit Viper bites in Thailand only 2 patients (0.9%) died from intracerebral hemorrhage, neither got antivenom (Wongtongkam *et al*, 2005).

Treatment costs are an important issue, especially in a country with poor resources. The price of 10 ml antivenin is THB 800 (about USD 24). The recommended initial dose of 30 ml for MPV and GPV bites would cost about USD 72. Although not affordable for many villagers in this province, this is quite reasonable compared with the price for a traditional snake bite healer who charges between

USD 30 and USD 50 for his most likely ineffective treatment.

The number of snakebites treated in the provincial hospital of Vientiane Province with about 400,000 inhabitants would suggest an incidence of about 3 per 100,000. The estimated incidence for the Southeast Asia region published by the WHO is 114 per 100,000 (Chippaux, 1998). The latter number is probably much closer to the real incidence and many snakebites are treated elsewhere, most likely by traditional healers in villages. Medical doctors in the hospitals have little knowledge about the diagnosis and treatment of snakebites and antivenom is not available. Therefore the snakebite victims rely on a traditional healer as they have for decades. An interview with a traditional snakebite healer revealed that he treats about one snakebite per month, covering more or less 10 of about 500 villages in the province. We could not confirm these data, and epidemiological studies are necessary to find out the real incidence in the region.

In summary, to our knowledge this is the first publication of venomous snakebites in the Lao PDR so far. Malayan and Green Pit Vipers were responsible for 21 venomous snakebites during an 18-month period in a provincial hospital 80 km north of the Lao capital Vientiane. About 50% of the victims had coagulopathies and 6 patients were treated successfully with monospecific antivenom. The training of medical doctors and health assistants regarding the clinical signs and treatment of snakebites and the indications for the use of antivenom is urgently needed in the Lao PDR. The population needs more information about "What to do", "What should not be done" and "Where to go" after a snake bite, and district and provincial hospitals should be able to provide professional help

in cases of venomous snake bites. Harmful first aid procedures, like cuts at the bite site, should be discouraged. A rapid test to detect snake venom in serum samples is needed, especially in this region where monospecific antivenom is used. More studies about the epidemiology of snakebites in different regions of the country are necessary to estimate the real incidence, morbidity and mortality of this neglected disease.

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