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Epidemiology, clinical features and management of common krait bite: a prospective study

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Summary

This study was designed to document clinical and epidemiological aspects and intensive care management of patients bitten by the common krait, *Bungarus caeruleus*. The study was started on 1st of January 1996 and all the admissions of common krait bites to General Hospital, Anuradhapura in 1996 were included.

Out of 42 patients, 25(60%) were severely envenomed and needed mechanical ventilation, 11 (26%) mild to moderatly envenomed, did not require ventilation and 6(14%) were non-envenomed inspite of proven bites. All the patients were from poor farming communities living in villages who had been bitten at night while sleeping on the floor. The majority of bites took place between 2200 and 0400hrs. In 29(69%) offending snakes were killed and available for identification. Commonest age group was 10 - 30 years (57%) and the majority of bites (83%) took place in the rainy season of the year, especially in October and November. The cardinal symptom was abdominal pain developing within hours, and other symptoms were dysphagia, dysphonia, drooping of eye lids, paresis of limbs and respiratory difficulties. Most patients [31(78%)] were admitted within 7 hr, and 17(40%) needed ventilatory support in 10 hr (range 3 to 50 hr), after the bite. In the ventilated group, duration of assisted ventilation ranged from 12 hr to 9 days (mode 4 days). 15(60%) went into total respiratory paralysis ("0" tidal volume) and 3(12%) within one hour after admission. The level of consciousness (LOC) was normal in 2, drowsy in 15, semiconscious in 1, and deep coma in 7. LOC had a direct significant correlation to the duration of ventilation ($r = 0.6386$, $p < 0.01$). Autonomic disturbance (AD) with hypertension, arrhythmia, tearing, sweating and salivation was seen in most patients. The deep coma mimicked brain death, but had a very good prognosis despite the associated complications (ARDS, AD, lung collapse, shock). Incidence of hypokalaemia in the first 48 hours was 71%. Recovery of neck flexion (power Gr 2-3) had significant correlation to onset of recovery of respiration ($r = 0.491$, $p < 0.05$) and it was used as a parameter in weaning off ventilation. Retrograde memory loss was observed in all recovered patients for variable duration (mode 3 days) which had no significant correlation to LOC and duration of ventilation. Doses of polyvalent antivenom above 10 - 20 ampoules had no significant benefit ($p < 0.05$) in reversing respiratory paralysis. Seven (17%) patients died due to ARDS in 4, arrhythmia in 1, poor resuscitation before admission in 2. At post mortem submucosal haemorrhage in stomach was a frequent finding.

Mortality in krait bites could be minimized with early and free access to ventilation. Evidence such as deep coma and retrograde memory loss suggest possible encephalopathic effect of krait venom, in addition to proven neuromuscular paralysis.

Key words - Common krait, Krait bite, Epidemiology Prospective study.

Introduction

The common krait (*Bangarus caeruleus* Schneider 1801) is a proteroglyphous elapid snake found in Sri Lanka, Pakistan, Bangladesh and India (Figure 1) (1,2,3,4). The highest incidence of its bites in Sri Lanka was reported from the North Central Province (NCP), where the vegetation and cli-

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Figure 1 : Common krait *(Bangarus caeruleus).* This specimen was 105 cm long.

mate provide an ideal habitat for snakes (1,2). Common victims of *Bangarus caeruleus* are farmers who live in open wattle-and-daub houses and farmers sleeping in watch huts in agricultural fields. A significant number of patients die before reaching a hospital. Surveys carried out in 1983 in Anuradhapura district (1,5) have shown that *Bangarus caeruleus* bites accounted for 45% of 110 deaths in the field due to snake bites. However, in recent years more patients have sought the life saving benefits of hospital treatment. The aim of the study was to gain a proper understanding of the clinical and epidemiological aspects of common krait bites and to develop a policy of management in the intensive care setup, based on the prospective observations.

Methods

This prospective study was started on 1st of January 1996 and all the admissions with common krait bites to General Hospital, Anuradhapura in that year were included. Patients were assessed at the time of admission and periodically, until the final outcome, and the details were recorded in a well designed information sheet. Autopsies were done on deaths and regular follow up studies were made on survivals.

Results

There were 42 patients with *Bangarus caeruleus* bites and 25(60%) of them were severly envenomed, needing mechanical ventilation in the intensive care unit. In 11(26%) patients envenomation was mild to moderate and did not require ventilation. Interestingly, in 6(14%) patients there were no signs of envenomation, in spite of proven bites with definitive fang marks where the killed offending snakes were available for identification. Overall, in 29(69%) patients, offending snakes were killed and brought along with the patients and identified as common krait by the author. In the rest, diagnosis was made on clinical grounds and on circumstantial evidence. It was a common observation that smaller kraits produced severe envenomation more often than larger kraits.

Socio-economic status, Time of bite, Seasonal distribution

All the patients were from poor farming families living in villages, most of them in cadjan-thatched, wattle- and -daub houses where they sleep on the floor. These houses were surrounded by uncleared vegetation which provides ample hideouts for the snakes. All the bites occurred at night while the victims were sleeping on the floor except in one case where the bite took place during the day, in a foot path. The majority of bites 35(83%) took place between 2200 to 0400 hr, indicating midnight preponderance.

A significant number of patients 13(31%) had not been aware of the bite but had woken up with colicky abdominal pain. In 12(28%) patients the site of the bite was undetectable.

The greatest number of krait bites (83%) occurred during the rainy season, especially in the months of October and November, when the North -East monsoon brings the highest rainfall to the region. It was our experience that most admissions for krait bites follow rainfall, even after an isolated shower during the drier months of the year.

Age and Sex Distribution

The sex ratio was equal and the age group commonly affected was between 10 - 30 years (57%). Patients at the extremes of age (below 10 years and above 60 years) were few, probably because

they died before reaching the hospital. Envenomation was extremely severe in children below 10 years of age, comprising 3(7%) patients.

Clinical Features

Abdominal pain is the first symptom that manifests after krait bite, within minutes to few hours, and it might mimic a surgical abdomen. In an unknown bite, the patient gets up in the night with colicky abdominal pain, mainly in the epigastrium, and may be misdiagnosed due to lack of awareness on the part of the medical practitioners (Table 1).

Other common clinical features were weakness of limbs, inability to stand up, drooping eye lids, double vision, difficulty in breathing, and changing sensorium, all of which progress rapidly to severe neuromuscular paralysis. Less commonly, myalgia, paraesthesia at the site of bite, decreased hearing and vision, and faintishness were observed. Very often the site of bite and fang marks were indistinct and hardly produced a local reaction. But bites in fingers and hand invariably produced significant local reaction with swelling and pain.

Most of the patients 31(71%) were admitted to hospital within 7 hours (range 1 to 20 hr) after the bite, a good indicator of the confidence of the general public in government hospital care.

Table 1

Incidence of different symptoms and signs on admission

Symptom/Sign	All patients	*Severe patients
Dyspnoea	65%	86%
Abdominal pain	64%	68%
Dysphagia	63%	73%
Chest pain	53%	59%
Faintishness	43%	45%
Giddiness	33%	32%
Myalgia	30%	32%
Vomiting	13%	18%
Ptosis	70%	82%
Weakness of limbs	63%	73%
Decreased consciousness	63%	77%
Weakness of neck flexors	58%	68%
Blurred vision	53%	64%
Decreased respiration	45%	73%
Local reaction	25%	18%

*Ventilated patients

Respiratory paralysis

Rapidly progressive neuromuscular respiratory paralysis in krait bite is invariably fatal if not detected and ventilated promptly. Severity of ventilatory failure is clinically undetectable as expressive ability of the patient has been lost due to paralysis of skeletal muscles. Therefore measurement of tidal volume and muscle power of neck flexors, were made regularly after admission. Once tidal volume fell below 200mL and power of neck flexors fell to less than grade 3, patients needed intubation and mechanical ventilation. In this study the time lag to initiation of ventilation was found to have a wide range (2 to 40hr) for the whole group and 17(40%) patients needed ventilation within 10 hr after the bite. 15(60%) of patients developed cessation of repiratory effort with no tidal volume during ventilation in the medical intensive care unit and 3(12%) of them within one hour after admission. This illustrates the rapidity of fatal manifestations and the need for quick resuscitation. Out of 42 patients, 25 were ventilated, and duration of ventilation ranged from 12 hours to 9 days (mode 4 days).

Level of consciousness

Alteration of level of consciousness was a common finding during the clinical course of these patients. The level of consciousness was arbitrarily classified into four grades, as the Glasgow coma scale was not applicable due to neuromuscular paralysis. They were normal, drowsy, semicoma, and deep coma.

Out of severely envenomed group the level of consciousness was normal in 2, drowsy in 15(61%), semiconscious in 1, and deep coma in 7(30%). The group of patients that went into a state of deep coma remained inert with beating heart, and mimicked brain death. Their brainstem reflexes and spinal reflexes were absent and the pupils remained fully dilated and light reflexes were absent. The onset of this stage varied from a few hours after bite up to 48 hours and lasted for days. They had a good prognosis but experienced more complications such as pulmonary collapse, hypostatic pneumonia, ileus, arrhythmia, and adult respiratory distress syndrome (ARDS). Four (58%) of these patients recovered completely and 2 patients died due to ARDS after they came out fully from deep coma, secondary to chemical pneumonits. The level of consciousness had a direct and significant correlation to the duration of respiratory paralysis ($r = 0.6386$, $p < 0.01$), as patients with deep coma needed longer duration of ventilation (Figure 2).

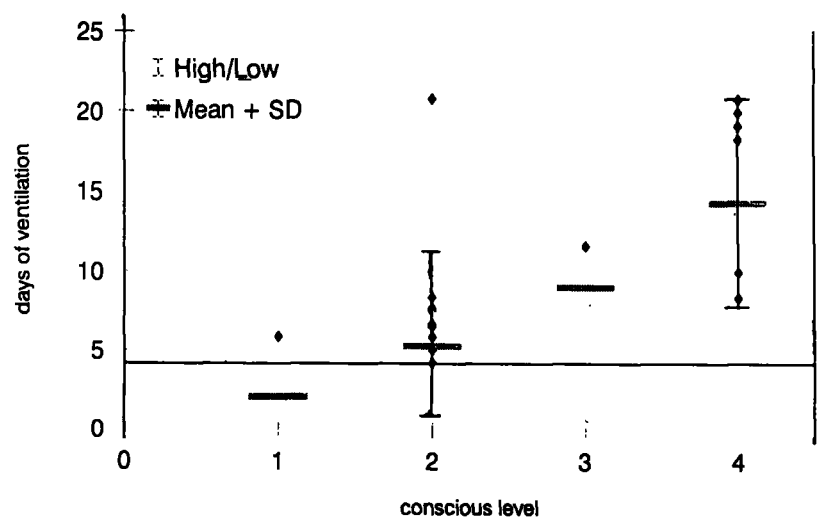

Figure 2 : Relationship of duration of ventilation to lowest conscious level
r=0.6386; p<0.001

Autonomic dysfunction

Autonomic dysfunctions were observed frequently, in the severely envenomed 25 patients. Increased sympathetic and parasympathetic activity were noted in some patients. Common dysfunctions were tachycardia, arrhythmia, hypertension, sweating, tearing, salivation, diarrhoea, mydraisis and paralytic ileus. They were pronounced in the first 48 hours and at times needed correction. Cardiac arrhythmias could be fatal, and they were not related to hypoxia as blood gases were maintained with effective ventilation.

Hypokalaemia

Significant hypokalaemia (serum potassium < 3.5 meq/L and U waves in ECG) were observed in 71% of patients during early stages, especialy in the first 48 hours. This was not related to respiratory alkalosis and needed replacement therapy, depending on severity. Further research is needed to ascertain the cause.

Specific treatment

As antivenom raised against common krait venom is not available, all patients in the series were given polyvalant Haffkine antivenom in different doses in the first 48 hours, regardless of the severity of the condition. There was no significant correlation between the duration of ventilation (recovery of ventilation) and dose of antivenom administered ($r = 0.0492$, $p < 0.5$). This means that higher doses of antivenom have no effect in reversing respiratory failure in common krait bite.

Outcome

This series of patients had an unexpectedly high mortality rate, in that 7(17%) patients died inspite of intensive care. Causes of death were ARDS in 4, arrhythmia in 1, poor resuscitation before admission in 2. Three patients developed ARDS while recovering from neuromuscular paralysis and died in spite of specific management. At autopsy the lungs were fully congested and haemorrhagic, and histology confirmed ARDS. Investigating their history revealed that three of them had visited indigenous medical practitioners prior to hospital admission and had nasal insuflation of herbal medicines *(gnasna)* which possibly had induced chemical pneumonits leading to ARDS. Autopsy of patients other than those who had ARDS, revealed large submucosal haemorrhagic patches in the gastric mucosa which were distinctive and might explain the abdominal pain in krait bite (Table 2).

Retrograde memory loss

After recovery, patients were questioned about the events that took place since the bite, in order to assess memory. All the patients who recovered had variable duration of memory loss (retrograde memory loss). The range was less than 24 hours to 8 days (mode 3 days). Duration of retrograde memory loss had no significant correlation to the lowest level of consciousness (LOC) ($r = 0.3587$, $p < 0.1$) and duration of respiratory paralysis ($r = 0.2458$, $P < 0.5$), so it was an independent and constant feature in severe envenomation.

Discussion

Although ecological and epidemiological aspects of common krait bite in Sri Lanka have been documented, studies on the clinical course and intensive care management of a large series of patients is not available, to formulate practical guidelines. Krait bites in the past carried a very high mortality. However with improved modern treatment facilities such as assisted ventilation and widely available intensive care units, there has been a dramatic reduction in the mortality rate.

Respiratory paralysis is the cardinal manifestation in krait bite and the rapidity of its development varies from patient to patient. Intubation and assisted ventilation started early prevents the development of hypoxic cerebral and cardiac damage. Deep coma and retrograde memory loss strongly suggest central cerebral effects of krait venom even though it is said to have only beta bungaratoxins which act on neuromuscular junctions (6). Hypokalaemia is a new finding which needs further research on its causation.

Table 2
Recovery of functions in severely envenomed patients (n = 17)

Recovered function	No. of patients	Mean (days)*
Cough reflex	9	2.4
Gag reflex	9	2.6
Normal consciousness	15	2.7
Ophthalmoplegia	17	3.4
Memory	13	3.8
Neck to power gr 2 -3	16	3.9
Normal respiration	17	4.0
Facial muscle	17	4.9
Ptosis	17	5.1
Distal muscles (hand grip/foot)	17	5.8
Proximal muscles (hip/shoulder)	17	7.5
Sitting up - unsupported	16	7.0
Neck to full strength	17	8.6

*mean number of days taken for full recovery of function

The polyvalent antivenom which is manufactured in India has doubtful efficacy in reversing established neuromuscular and respiratory paralysis. The work of former investigators (6) clearly shows clearance of venom antigenaemia with intravenous polyvalent antivenom. The inference is that it has no effect on bound antigen in neuromuscular junctions which occur quite rapidly with envenomation. Development of a monospecific antivenom is needed, specific to local species of the common krait.

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