ORIGINAL ARTICLE

An Experience with Manual Ventilation in Respiratory Paralysis Due to Indian Common Krait (*Bungarus caeruleus*) Bite

ASHISH BHALLA[1,*], VIKAS SURI[2], NAVNEET SHARMA[1], SURJIT SINGH[3]

[1] Additional Professor, Department of Internal Medicine, Post Graduate Institute of Medical Education and Research, Chandigarh, India
[2] Assistant Professor, Department of Internal Medicine, Post Graduate Institute of Medical Education and Research, Chandigarh, India
[3] Professor, Department of Internal Medicine, Post Graduate Institute of Medical Education and Research, Chandigarh, India

Abstract

Background: Bungarus caeruleus (common krait) bite during monsoon season is common in northwest India. Respiratory failure is responsible for high mortality in the victims. In this study we report our experience with manual ventilation using bag valve mask (BVM) in patients with neuroparalysis due to common krait bite.
Methods: This prospective study was conducted between June 2009 and December 2009. All consecutive patients with diagnosis of common krait bite who were manually ventilated by BVM were studied. The duration of ventilation and complications associated with ventilation were noted. Polyvalent anti snake venom was administered as per the "national snake bite protocol" and patients were followed up until final outcome.
Results: Thirty-four patients (70.6% men) were studied. All patients except two came from rural areas and they were hospitalized between June and September. Majority of patients were bitten during the night while sleeping on the floor. The mean time interval between bite and arrival to hospital was 4.4 hours. Ptosis (100%) was he most common clinical finding followed by ophtalmoplegia (80%) and limb muscle weakness (74%). Twenty-four patients (70%) developed respiratory symptoms and 20 (59%) were intubated and manually ventilated by BVM. Mean duration of assisted ventilation was 34.6 ± 12.8 hours. Hoarseness of voice and throat pain were noted in all intubated patients following extubation, which responded to conservative therapeutic measures. The mean duration of hospitalization was 6 ± 1.6 days. All patients except one survived.
Conclusion: Manual ventilation with BVM in patients with neuroparalysis due to common krait bite is a safe and effective modality in resource constraint settings.

Keywords: Artificial Respiration; Bungarus; India; Neurotoxicity Syndromes; Snake Bites

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INTRODUCTION

The common krait (*Bungarus caeruleus*) is one of the most toxic snakes found in the plains of northwest India. The majority of bites by this snake occur during the monsoon season, especially in the months of July to September (1-3). Kraits are generally nocturnal, shy and non-aggressive but can bite when disturbed by sleeping humans, either naturally, or during rapid eye movement phase of sleep (4). Their bites are usually painless, causing minimal or no swelling and no necrosis as opposed to cobra (*Naja naja*) bites which can cause severe local symptoms (1). Both cobra and common krait belong to elapidae snakes family that their venoms contain specific neurotoxins causing neurologic complications such as respiratory muscles paralysis, bulbar palsy and ptosis. Because of limited local effects, considerable number of patients dies before reaching a hospital, largely due to the fact that they are unaware that they have been bitten (1-3).

The mortality rate reported from snake envenomation in northwestern India is as high as 77% (5). The availability of assisted ventilation and improvement in critical care practices has resulted in lower mortality in patients who reach hospital in time. Limited availability of anti-snake venom (ASV) in regional healthcare facilities and non-availability of ventilators have forced medical practitioners to refer patients to tertiary care centers. Since the number of ventilators is limited even in the best medical settings, all the referred patients may not receive mechanical ventilation and thus should be managed with bag valve mask (BVM, also known as bag-valve resuscitation device or Ambu bag).

We have earlier reported usefulness of manual ventilation in a snakebite victim with neuroparalytic effects (6). Here, we present our experience of artificial respiration provided by BVM in a series of patients with neuroparalysis secondary to common krait bite.

METHODS

All consecutive patients admitted to Nehru hospital affiliated to Post Graduate Institute of Medical Education

*Correspondence to: Ashish Bhalla, MD. Department of Internal Medicine, Post Graduate Institute of Medical Education and Research, Sector 12, Chandigarh 160012, India.
Tel: +91 941 702 3973, E-mail: bhalla.chd@gmail.com
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and Research, Chandigarh, India, between June 2009 and December 2009 with diagnosis of common krait bite, identified either from brought snake or circumstantial evidence were included. Details about demographic parameters, time and site of bite, elapsed time from bite to admission to the hospital, clinical manifestations on admission, development of respiratory paralysis and the need for intubation and ventilation were recorded.

Patients were assessed on admission and then periodically until final outcome. Neurotoxicity was assessed by ptosis, eye movements, pupilary size and reaction to light, power of neck flexors and limbs, respiratory rate, chest expansion, strength of speech, level of consciousness, blood pressure and local effects. Victims having local signs of swelling, bleeding or necrosis were excluded from the study group. The muscle strength was graded from 0 to 5 using British Medical Research Council criteria (7).

We also noted the duration of ventilation and complications associated with ventilation in these patients. All patients with neuroparalytic bite received ten vials of polyvalent ASV (Serum Institute of India Ltd, Pune, India) intravenously followed by another 10 vials if the paralysis did not improve or worsened, as per the national snake bite protocol (8). All patients who were manually ventilated by BVM were analyzed. Patients were manually ventilated by their family members or friends. The patients' relatives were informed regarding the need of ventilation and non-availability of mechanical ventilator. The correct methodology of using BVM was taught to the relatives by the residents working in the emergency department and was supervised by them. The relatives were explained to take turns and change every 30 minutes to prevent exhaustion. The exchange was also supervised by the residents. Since a previous study conducted by the authors had failed to prove any benefit of neostigmine in these patients, the drug was not administered to the study population (9). Mortality was the primary endpoint in our study followed by duration of ventilation, duration of hospitalization and complications observed. The data was analyzed using SPSS version 10 (SPSS Inc., Chicago, USA) and presented as mean or percentages.

RESULTS

Demographic features

A total of 34 patients were admitted during the study period. There was a male preponderance with male: female ratio of 2.4: 1. All patients except two came from rural areas and they were hospitalized between June and September. All patients were laborers.

Circumstances of bite

All patients were bitten when sleeping on the floor. Only 4 patients brought the offending snakes which could be morphologically identified as common krait. For all the other patients, presence of neuroparalysis without any evidence of local symptoms and signs suggested krait bite. The mean time interval between bite and arrival to hospital was 4.4 hours (range: 45 minutes to 12 hours). Eighty-five percent of the patients were bitten during 12 midnight to 6 a.m. and 50% had a bite on the lower limbs and the next commonest sites were upper limbs (20%).

Clinical manifestations

Abdominal pain was the first symptom that manifested within a few minutes to hours in 88.2% of the patients. Other common clinical features were ptosis (100%), ophtalmoplegia (80%), limb muscle weakness (74%) and difficulty in breathing (70.6%) (Table 1). Paraesthesia at the bite site was reported by only 1 patient. In all patients, the fang marks were indistinct and no local reaction was observed.

Table 1. Symptomatology of patients with *Bungarus caeruleus* envenomation

Clinical manifestation	No. (%)
Ptosis	34 (100)
Abdominal pain	30 (88.2)
Weakness of neck flexors	30 (88.2)
Difficulty in breathing	24 (70.6)
Respiratory failure	20 (58.8)
Vomiting	10 (29.4)
Hypertension	6 (17.6)
Nausea	3 (9.9)
Altered sensorium	3 (9.9)
Diplopia	3 (9.9)
Fasciculation	2 (6.5)

Treatments

Ten patients had respiratory distress on admission, while 10 more patients developed respiratory paralysis during their admission. These twenty patients were intubated and manually ventilated by BVM. Mean duration of intubation was 44.5 ± 16.2 hours (range: 12-106 hours) and mean duration of assisted ventilation was 34.6 ± 12.8 hours (range: 10-96 hours). Only 2 patients that were bitten behind their ear and developed severe paralysis, required prolonged ventilation for more than 100 hours. All the 20 patients were manually ventilated by their family members (40%) or friends (60%).

Ten patients required only an initial dose of 10 vials of ASV and responded to it. The rest of the 24 patients received 20 vials of ASV.

Outcomes

All the manually ventilated patients were given a trial of spontaneous breathing after a mean duration of 12 hours and subsequently every 6 hours. Presence of paradoxical breathing was the indicator to put the patient back on manual ventilation. The earliest indicator of improvement of neuromuscular paralysis was ability to lift the head from bed followed by raising the arms up in the air. Six patients had persisted weakness in upper limbs with muscle strength less than grade 3 following discontinuation of ventilation which improved during the next 12 hours. The mean duration of hospitalization was 6 ± 1.6 days.

Only one patient died in our study group and the death was related to the hypoxic brain damage due to the failure of the relatives to ventilate the patient for a night (the relative felt asleep). There were no notable complications related to intubation in our study. Hoarseness of voice and throat pain were noted in all intubated patients following extubation, which responded to conservative therapeutic measures. Only 4 patients developed fever that was due to thrombophlebitis at the injection site. The major setback noted was exhaustion in the patients' relatives that resulted in death of one patient.

DISCUSSION

It is estimated that around 45,000 people die due to snake bites annually in India, more so in the rural areas (10). It is well established that in northwestern India, common krait is the commonest cause of neuroparalysis following snake bite (9,11-13). Timely administration of ASV and supportive therapy are the key factors that can improve the outcomes in these snakebite victims. Some studies showed that ASV administration may hasten the recovery (9,11), but supportive therapy in the form of ventilation can save the victim's life even in the absence of ASV administration (12).

In our study, men were bitten nearly twice more than women which is in contrast to the observations by Kularatne et al. from Sri Lanka where men and women were equally affected (14). Majority of affected men are migrant agricultural laborers in northern India. Since many of them may not be accompanied by their wives or children, the incidence is lower in women and children (9,11,13).

The earliest symptom of systemic elapid envenomation is a feeling of drowsiness. Subsequently, selective neuro-muscular blockade affecting mainly the muscles of eyes, tongue, pharynx, chest and finally limbs occurs (15,16). These manifestations usually develop within 1 to 4 hours of bite. Bilateral ptosis is usually the commonest noted early sign (14). In severe or fatal envenomation, paralysis of intercostal muscles results in respiratory failure. This manifests as air hunger, confusion, stupor, coma, convulsions and ultimately leading to death. Timely institution of assisted ventilation can improve the outcome in severely paralyzed patients (3).

The venom of common kraits contains 3 major neurotoxins (α, β and κ-bungarotoxin) that can induce failure of neuromuscular transmission resulting in respiratory muscles paralysis. α-bungarotoxin and κ-bungarotoxin bind to postsynaptic neuronal acetylcholine receptors, while β-bungarotoxin induces depletion of synaptic vesicles at presynaptic nerve terminals (17-19). The structural damage to motor nerve terminal is completed by 12 to 24 hours (17-20). Recovery depends on the regeneration of synaptic vesicles which takes long time necessitating prolonged mechanical ventilation. Literature supports the need for prolonged ventilatory support in krait envenomation (9,11,15,16). Rapid irreversible binding of β-bungarotoxin to its binding site on nerve terminals leads to poorer response to ASV therapy (17,19,20), as ASV has practically no effect on the bound antigen (21).

The majority of our patients developed worsening of respiratory paralysis and required assisted ventilation despite ASV administration; yet, the mean duration of assisted ventilation was much shorter than that in other studies (11,14,22). The mortality rate in our study was less than a previously reported series by Bawaskar et al. (3% vs. 40%) (23). The reason for lower mortality in our study is probably the earlier administration of assisted ventilation with BVM and availability of intensive care facilities, a fact highlighted by earlier studies from our center (6,9). In a previous study from our center, futility of neostigmine in confirmed common krait envenomation was proven (9). Therefore, we did not administer neostigmine to our patients.

During monsoon season, when the patient load overwhelms the available facilities, the use of alternative strategies and BVM has majorly helped us (6). Our study firmly establishes a fact earlier highlighted that ventilation either mechanically or manually is the most important supportive treatment needed by krait bite victims (9,23-27).

Many snakebite victims in developing countries end up in hospitals that have only basic medical facilities and no mechanical ventilatory support. Hence, we would like to convey a message that a simple BVM with handful of dedicated relatives can make a material difference in the outcome of krait bite victims. BVM should be used to provide airway support in rural/resource constraint settings (8,9,24). This also encourages us that even with minimum support; we can save a victim of neuroparalytic snakebite during the time of transfer to a better equipped center.

CONCLUSION

Manual ventilation with BVM in patients with neuroparalysis due to common krait bite is a safe and effective modality in resource constraint settings. Non-availability of mechanical ventilator should not discourage a physician from making an attempt to initiate the treatment for such patients in centers with basic facilities when awaiting transfer to a setting with available mechanical ventilation.

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