

Treatment of ASV used by King Cobra Bite

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The king cobra (*Ophiophagus hannah*) is an elapid found predominantly in forests from India through Southeast Asia. This species is the world's longest venomous snake, with a length up to 18.5 to 18.8 ft (5.6 to 5.7 m). Despite the word "cobra" in its common name, this snake is not a member of the *Naja* genus ("true cobras"), which contains most cobra species, but the sole member of its own genus. It preys chiefly on other snakes and occasionally on some other vertebrates, such as lizards and rodents. The king cobra is considered to be a dangerous snake and has a fearsome reputation in its range, although it typically avoids confrontation with humans if possible. It is also considered culturally significant and has many superstitions around it. Many sophisticated design techniques, superior materials, and an exceptional connection system combine to make King Cobra possible. Whether used single ended (RCA plugs) or balanced (XLR plugs), King Cobra's open and natural sound is obvious.

Design Basics

King Cobra is Triple-Balanced. This means there are three identical insulated conductors, in addition to a separate conductor underneath the 100% coverage foil shield. When used with XLR connectors and balanced electronics, the two positive signals (inverting and non-inverting) and the negative, all get the same low-distortion conducting path. The shield is attached to chassis ground through the case of the XLR, providing extremely effective shielding without contaminating the quality of the negative conducting path. When King Cobra is fitted with RCA plugs, two conductors are used together for the much higher potential across the negative connection, providing a substantial performance advantage. The shield is only attached at one end, providing total shield coverage without compromising the negative conducting path.

Conductors

All of King Cobra's conductors are solid. Electrical and magnetic interaction between strands in a conventional cable is the greatest source of distortion, often causing a somewhat dirty harsh sound. Solid conductors are fundamental toward achieving King Cobra's very clean sound.

Metal

PSC+ (Perfect-Surface Copper+) has an astonishingly smooth and pure surface. Proprietary metal processing technology protects the wire's surface at every stage of drawing and fabrication. When highpurity low-oxide copper is kept as soft, pure and smooth as possible, it becomes a wonderfully low distortion PSC conductor. PSC+ is manufactured by applying the same exceptional technology to an ultra pure copper. The resulting sound quality is even more focused and simply less in-the-way. For fifteen years AudioQuest has pioneered the use of superior metals; yet even we were surprised by the huge leap in performance made possible with Perfect-Surface Technology. PSC+ simply outperforms all previously available metals at any price.

Insulation

Any solid material adjacent to a conductor is actually part of an imperfect circuit. Wire insulation, circuit board materials all absorb energy (loss). Some of this energy is stored and then released as distortion. All of King Cobra's conductors use PE Air Tubes insulation because air absorbs next to no energy, and Polyethylene is low-loss and has a benign distortion profile. Thanks to all the PE Air Tubes, it causes much less of the out-of-focus effect common to other materials. A combination of these major ingredients, and many more subtle details add up to explain how King Cobra can sound so wonderfully clean, clear and dynamic.



Solid Perfect-Surface
Copper+ (PS
C+)
PE
Air Tubes
Silver-Plated
Cold-Welded, Drainwire
Direct Silver-Plating
KING ANALOG AUDIO INTERCONNECT

Triple Balanced Design

3 x 21 AWG Solid Perfect-Surface Copper+(PSC) Conductors
Polyethylene Air Tube Insulation
22 AWG Solid Silver-Plated Long-Grain Copper (SP-LGC) Drainwire
Foil/Mylar/Foil Shield
Red PVC Jacket
Black/Red - Nylon Braid

Noise-Dissipation System

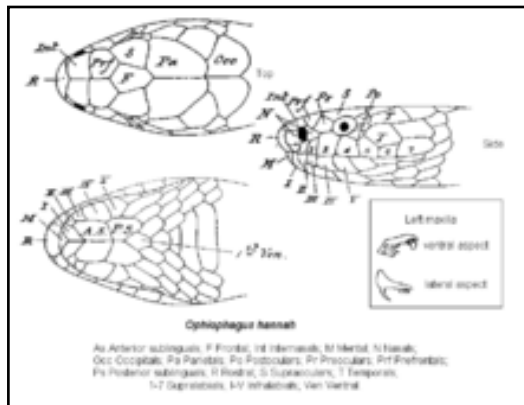
100% shield coverage is easy. Preventing captured RF Interference from modulating the equipment's ground-reference requires AQ's Noise-Dissipation System. Metal and Carbon-Loaded synthetics prevent most RFI from reaching the equipment's ground-plane. King Cobra's gold plated RCA plugs use a patented design that eliminates the distortion caused by the extra contact inside most plugs. Because the ground shells are stamped instead of machined, the metal can be chosen for low distortion instead of for its machinability.

Cold-Weld System

Novel plug design enables a perfect heat-free connection

Physical Appearance

The king cobra averages at 3 to 4 m (9.8 to 13.1 ft) in length and typically weighs about 6 kg (13 lb). The longest known specimen was kept captive at the London Zoo, and grew to around 18.5 to 18.8 ft (5.6 to 5.7 m) before being euthanised upon the outbreak of World War II. The heaviest wild specimen was caught at Royal Island Club in Singapore in 1951, which weighed 12 kilograms (26 lb) and measured 4.8 m (16 ft), though an even heavier captive specimen was kept at New York Zoological Park and was measured as 12.7 kilograms (28 lb) at 4.4 m (14 ft) long in 1972. The length and mass of the snakes highly depend on their localities and some other factors. Despite their large sizes, typical king cobras are fast and agile. Some viper species, such as Eastern diamondback rattlesnakes and Gaboon vipers, often much shorter in length but bulkier in build, rival the King cobra in average weight and reportedly best them in maximum weight.



Scalation of the king cobra

The skin of this snake is either olive-green, tan, or black, and it has faint, pale yellow cross bands down the length of the body. The belly is cream or pale yellow, and the scales are smooth. Juveniles are shiny black with narrow yellow bands (can be mistaken for a banded krait, but readily identified with its expandable hood). The head of a mature snake can be quite massive and bulky in appearance, though like all snakes, they can expand their jaws to swallow large prey items. It has proteroglyphdentition, meaning it has two short, fixed fangs in the front of the mouth, which channel venom into the prey like hypodermic needles. The male is larger and thicker than the female. The average lifespan of a wild king cobra is about 20 years.

The dorsal scales along the centre of the king cobra’s body have 15 rows. Males have 235 to 250 ventral scales, while females have 239 to 265. The subcaudal scales are single or paired in each row, numbering 83 to 96 in males and 77 to 98 in females.

Taxonomy



The chevron pattern on the neck *Ophiophagus hannah* belongs to the monotypic genus *Ophiophagus*. It is classified under the family Elapidae.

The king cobra is the sole member of genus *Ophiophagus*, while most other cobras are members of the genus *Naja*. They can be distinguished from other cobras by size and hood. King cobras are generally larger than other cobras, and the stripe on the neck is a chevron instead of a double or single eye shape that may be seen in most of the other Asian cobras. Moreover, the hood of the king cobra is narrower and longer.[2] A foolproof method of identification is if on the head, clearly visible, is the presence of a pair of large scales known as occipitals, at the back of the top of the head. These are behind the usual “nine-plate” arrangement typical of colubrids and elapids, and are unique to the king cobra.

The species was first described by the Danish naturalist Theodore Edward Cantor in 1836.

Distribution and habitat

The king cobra is distributed across the Indian Subcontinent, Southeast Asia, and the southern areas of East Asia (where it is not common). It lives in dense highland forests,[1] [9] preferring areas dotted with lakes and streams. King cobra populations have dropped in some areas of its range because of the destruction of forests. It is listed as an Appendix

Behavior



Captive king cobras with their hood extended.



A king cobra, like other snakes, receives chemical information via its forked tongue, which picks up scent particles and transfers them to a special sensory receptor (Jacobson's organ) located in the roof of its mouth.[1] This is akin to the human sense of smell. When the scent of a meal is detected, the snake flicks its tongue to gauge the prey's location (the twin forks of the tongue acting in stereo); it also uses its keen eyesight (king cobras are able to detect moving prey almost 100 m [330 feet] away), intelligence,[11] and sensitivity to earth-borne vibration to track its prey.

Following envenomation, the king cobra will begin to swallow its struggling prey while its toxins begin the digestion of its victim. King cobras, like all snakes, have flexible jaws. The jaw bones are connected by pliable ligaments, enabling the lower jaw bones to move independently. This allows the king cobra to swallow its prey whole, as well as letting it swallow prey much larger than its head.

King cobras are able to hunt throughout the day, and it is rarely seen at night, leading most herpetologists to classify it as a diurnal species.



A king cobra in the St. Louis Zoo with the hood retracted



Diet



A king cobra in its defencing posture (mounted specimen at the Royal Ontario Museum).

The king cobra's generic name, *Ophiophagus* is a Greek-derived word which means "snake-eater", and its diet consists primarily of other snakes, including ratsnakes, small pythons and even other venomous snakes such as various members of the true cobras (of the genus *Naja*), and even the krait. When food is scarce, they may also feed on other small vertebrates, such as lizards, birds, and rodents. In some cases, the cobra may "constrict" its prey, such as birds and larger rodents, using its muscular body, though this is uncommon.[1][13] After a large meal, the snake may live for many months without another one because of its slow metabolic rate. The king cobra's most common meal is the ratsnake; pursuit of this species often brings king cobras close to human settlements.

Defence

When confronted, this species will quickly attempt to escape and avoid any sort of confrontation [4][14]. However, if continuously provoked, the king cobra can be highly aggressive [4, 8]

When concerned, it rears up the anterior portion (usually one-third) of its body when extending the neck, showing the fangs and hissing loudly [2, 8]. It can be easily irritated by closely approaching objects or sudden movements. When raising its body, the king cobra can still move forward to strike with a long distance [8] and people may misjudge the safe zone. This snake may deliver multiple bites in a single attack but adults are known to bite and hold on. It is secretive and tends to inhabit less-populated forested regions and dense jungle, and thus many victims bitten by king cobras are actually snake charmers.

Some scientists believe that the temperament of this species has been grossly exaggerated. In most of the local encounters with live, wild king cobras, the snakes appear to be of rather placid disposition, and they usually end up being killed or subdued with hardly any hysterics. These support the view that wild king cobras generally have a mild temperament, and despite their frequent occurrence in disturbed and built-up areas, are adept at avoiding humans. Naturalist Michael Wilmer Forbes Tweedie felt that "this notion is based on the general tendency to dramatise all attributes of snakes with little regard for the truth about them. A moment's reflection shows that this must be so, for the species is not uncommon, even in populated areas, and consciously or unconsciously, people must encounter king cobras quite frequently. If the snake were really habitually aggressive records of its bite would be frequent; as it is they are extremely rare

If a king cobra encounters a natural predator, such as the mongoose, which has resistance to the neurotoxins,[17] the snake generally tries to flee. If unable to do so, it forms the distinctive cobra hood and emits a hiss, sometimes with feigned closed-mouth strikes. These efforts usually prove to be very effective, especially since it is much more dangerous than other mongoose prey, as well as being much too large for the small mammal to kill with ease.

A good defence against a cobra for anyone who accidentally encounters this snake is to slowly remove a shirt or hat and toss it to the ground while backing away

The Growling Hiss

The hiss of the king cobra is a much lower pitch than many other snakes and many people thus liken its call to a "growl" rather than a hiss. While the hisses of most snakes are of a broad-frequency span ranging from roughly 3,000 to 13,000 Hz with a dominant frequency near 7,500 Hz, king cobra growls consist solely of frequencies below 2,500 Hz, with a dominant frequency near

600 Hz, a much lower sounding frequency closer to that of a human voice. Comparative anatomical morphometric analysis has led to a discovery of tracheal diverticula that function as low-frequency resonating chambers in king cobra and its prey, the mangrove rat snake, both of which can make similar growls [19].

Reproduction



A captive juvenile king cobra in its defensive posture.

The king cobra is unusual among snakes in that the female king cobra is a very dedicated parent. She makes a nest for her eggs, scraping up leaves and other debris into a mound in which to deposit them, and remains in the nest until the young hatch. A female usually deposits 20 to 40 eggs into the mound, which acts as an incubator. She stays with the eggs and guards the mound tenaciously, rearing up into a threat display if any large animal gets too close, for roughly 60 to 90 days. Inside the mound, the eggs are incubated at a steady 28 °C (82 °F). When the eggs start to hatch, instinct causes the female to leave the nest and find prey to eat so she does not eat her young. The baby king cobras, with an average length of 45 to 55 cm (18 to 22 in), have venom which is as potent as that of the adults. They may be brightly marked, but these colours often fade as they mature. They are alert and nervous, being highly aggressive if disturbed.

Venom



King cobra skull, lateral view, showing fangs

The venom of the king cobra consists primarily of neurotoxins, known as thehaditoxin, with several other compounds. Its murine LD toxicity varies from intravenous 1.31 mg/kg and intraperitoneal 1.644 mg/kg] to subcutaneous 1.7—1.93 mg/kg.

This species is capable of delivering a fatal bite and the victim may receive a large quantity of venom with a dose anywhere from 200 to 500 mg or even up to 7 ml Engelmann and Obst (1981) list the average venom yield at 420 mg (dry weight). Accordingly, large quantities of antivenom may be needed to reverse the progression of symptoms developed if bitten by a king cobra. The toxins purposely target at the victim's central nervous system, resulting in severe pain, blurred vision, vertigo, drowsiness, and eventually paralysis. If the envenomation is serious, it progresses to cardiovascular collapse, and the victim falls into a coma. Death soon follows due to respiratory failure. Moreover, envenomation from king cobras is clinically known to cause renal failure as observed from some snakebite precedents of this species though it is uncommon. Bites from a king cobra may result in a rapid fatality which can be as early as 30 minutes after the envenomation. [The king cobra's envenomation was even recorded to be capable of killing elephants within hours.

There are two types of antivenom made specifically to treat king cobra envenomations. The Red Cross in Thailand manufactures one, and the Central Research Institute in India manufactures the other; however, both are made in small quantities and, while available to order, are not widely stocked. Ohanin, a protein component of the venom, causes hypolocomotion and hyperalgesia in mammals.] Other components have cardiotoxic, cytotoxic and neurotoxic effects. In Thailand, a concoction of alcohol and the ground root of turmeric is ingested, which has been clinically shown to create a strong resilience against the venom of the king cobra, and other snakes with neurotoxic venom [36]. Proper and immediate treatments are critical to avoid the occurrence of death. Successful precedents include a client who recovered and was discharged in 10 days after being treated by accurate anti-venom and inpatient care.

Snakebites from this species are rare and most victims are actually snake handlers. Not all king cobra bites result in envenomation but are often considered of medical importance. [Clinical mortality rates vary among different regions and depend on many factors, such as local medical advancement. A Thai survey reports 10 deaths out of 35 patients received for king cobra bites, whose fatality rate posed (28%) is higher than those of other cobra species. A six-year-reviewing report published by South Indian Hospital reveals that two-thirds of the patients bitten by king cobras were graded "severe", though none died at the end due to proper medical treatments. Department of Clinical Toxinology in University of Adelaide gives this serpent a general untreated fatality rate of 50-60%, implying that the snake has about a half chance to deliver bites involving non-fatal quantities of venom.

Cobra Bite

Cobra bite also tends to occur during daytime, when the transportation is more readily available. Moreover, because of known severity of envenoming patients and relative, make hurry to report to hospital rather than killing time to go to village healer. Cobra venom is potent cardiotoxic, neurotoxic, hematotoxic, cytotoxic. The fangs are small and sharp.

Treatment with ASV

History of snake bite or evidence of fangs marks should not be the indication of anti-snake venom. There should be signs and symptoms suggestive of envenoming. Initial 100 ml ASV to be added 200 ml of crystalloid solution administered over 60 minute by intravenous route in a victim of krait, cobra and Russell's viper envenoming. It neutralizes the circulating venom, while the venom

absorbed slowly from the site of bite which act as depot can be neutralized by 50 ml of ASV by slow continuous intravenous drip over 12 hours for 24 hours then reduced the dose as per clinical improvement.

While the total initial dose required for *Echis carinatus* envenoming is 20-40 ml over one hour and 20 ml over next 24 hours. ASV may be administered even after 12-14 days after viper bite if systemic toxicity present. Thus, you are never late to administer the ASV in a viper bite with systemic involvement.

After initial dose of anti-venom the active bleeding such as hematemesis, hematuria, bleeds from wound do not disappear within 20-30 minute particularly in viper bite one can repeat 20-50 ml antivenom an addition extra bolus.

Twenty minute whole blood clotting test (20 WBCT) this is most gold standard bedside test can be performed by unskilled staff. Before injecting ASV from same veinpuncture 2-3 ml of blood is withdrawn and added to a dry glass tube (not washed with detergent) is kept standstill and observed after 20 minute, tipped of the blood did not clot confirmed hypofibrinogenemia. This test should not be repeated with 6 hours after the dose of ASV, as liver took six hours for synthesis of coagulants factors. 20 WBCT test decides the further requirement of ASV. This test is important for diagnosis and also indicates the improvement²¹. Once the venom is attached to target organs (receptors) such as neuromuscular receptors, red blood cells, platelets, renal tubules and myocardium then any amount of ASV will not able to reverse the effects. Elapidae venom blocks the acetylcholine receptors, this action of venom can be reversed by neostigmine in the dose of 25 microgram per kg per hour precede by atropine Postsynaptic receptors blocked by cobra venom is totally reversed by choline-esterase inhibitor, while in krait bite venom blocks both pre- and postsynaptic receptors in early stage neostigmine may help to delay the respiratory depression. Artificial ventilator by mechanical ambu bag or ventilator indicated with grade 3 power, pulling of saliva, or tidal volume below 200 ml. Hypotension, bradycardia to be treated with atropine and dopamine drip. Complete heart block in cobra bite need isoprenaline drip at rural area and ASV and temporary pacemaker.

Renal Failure

Close monitoring of urine out is crucial important. Early detection of renal failure in Russell's viper bite. Early failure treated by intravenous frusemide 200-500 mg or torasemide by continuous intravenous drip and dopamine drip with fluid restriction. Rise in serum creatinine >9 need renal or peritoneal dialysis.

Profuse Bleeding

Can be treated by blood transfusion. Shock due to accumulation of fluid in compartmental syndrome or muscles damage can be prevented by surgical decompression but following criteria should be fulfilled before surgical procedure.

1. Marked tenderness over muscles
2. Pain during passive movement of muscles.
3. Loss of sensation or hypo-aesthesia over in the supply of a nerve passing through the compartment.

Is test dose of ASV essential? No, because even if victim is sensitive to ASV, does not preclude its use.

Treatment of Anaphylaxis

Intravenous clorpheniramine maleate, hydrocortisone, intramuscular adrenaline, to be repeated every 5-7 minutes, or if not responding then intravenous adrenaline drip or 1 ml 1:1000

adrenaline diluted in 20 ml of saline to be administered over 20 minutes by slow drip. Late serum sickness developed 5-24 (mean 7) days after antivenom; characterized by fever, bodyache, itching, urinary and arthralgia, mononeuritis multiplex. At times, involvement of serous membrane, lymphadenopathy. This serum sickness responds to steroids.

India is an agricultural country; snake bite poisoning is endemic, hence there should be an attempt to prepare venom toxoid to immunize farmers and farm laborers. Intramuscular injection should be avoided till blood fails to clot.

Total requirement of ASV dose can be reduced by preparing mono-specific ASV or purified F(ab)₂ ASV. ELISA kit for detection of venom antigen helps the treating doctor to know the exact species of snake and even helps to monitor the circulating venom antigen and thus the dose of ASV.

Prevention—Fire wood, cow dung, cattle shed and rubble should be kept away from residential house. Old storage rubble particularly in an old house should be handled in full sunlight. Bare-foot walking in arkness, in grown-up grass should be avoided or one should go out with a torch. Proper care of rats, mice and lizards; they can be killed by rat poison. No attempt should be made to catch snake or to kill it. Killed snake should not be handled; even sheared head may inject venom. Thick electrician gloves with rubber shoes should be worn at the time of handling the Jawar or paddy or sugarcane husk.

Training in appropriate use of antivenom and protocol of indications for its use should be arranged at the general hospital level to ease the crisis of supply of antisnake venom and mere history of snake bite should not be the indication of administration of antisnake venom.

Medical officers should be trained how to do endotracheal intubations and ambu bag respiration.

Ambu bag with necessary requirement must be made available at any dispensary including primary health centers and facilities of ventilator and renal dialysis should be mandatory at rural, cottage and districts hospital if we want to reduce the fatality of snake bite in agricultural country India²³.

ASV causes a severe reaction; it is expensive hence toxicologists should make an attempt to synthesise the pharmacological antidote to venom action or should prepare a chemical receptor so that the venom might attack the external injected receptors and protect the natural receptors.

Conservation

In India, King Cobras are placed under Schedule II of Wildlife Protection Act, 1972 (as amended) and a person guilty of killing the snake can be imprisoned for up to 6 years Cultural significance In Burma, king cobras are often used by female snake charmers. Members of the Pakkoku clan tattoo themselves with ink mixed with cobra venom on their upper body in a weekly inoculation which potentially might protect them from the snake, though there is no scientific evidence of that.^[40] The charmer is usually tattooed with three pictograms The charmer kisses the snake on the top of its head at the end of the show ^[13].

In the Indian Subcontinent, the king cobra is believed to possess exceptional memory. According to a myth, the picture of the killer of a king cobra stays in the eyes of the snake, which is later picked up by the partner and is used to hunt down the killer for revenge. Because of this myth, whenever a cobra is killed, especially in

India, the head is either crushed or burned to damage the eyes completely.

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Outstanding services, Achievements, Contributions, Meritorious Services, Outstanding Performance and Remarkable Role in the field of Education and Service to the Nation He has been listed as One among the Top Three Faculty in JNTU Hyderabad, AP, India.



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