Surgical Intervention in injured snakes rescued in eastern Assam, India

Injured King Cobra

Pain perception in lower vertebrates is comparable to that in mammals but at the same time ascertaining the clinical signs of pain in reptiles is very difficult (Eatwell 2010). This necessitates the use of anaesthetic and analgesic agents during any invasive and painful procedures in reptiles (Machin 2001). Anaesthetising reptiles is difficult, especially with respect to the monitoring of the depth of anaesthesia, vital parameters and thermo-regulation (Brattstrom 1965). Their slower basal metabolic rates further compound the problems due to altered and unpredictable pharmacokinetics especially while using injectable anaesthetics. Although gaseous anaesthesia on most of the occasion is the ideal method of anaesthetizing reptiles, the use of IV/IM anaesthetics is also valuable and less cumbersome. The heavy equipment, adequate expertise requirement and overall logistical costs of gaseous anaesthesia, makes it unavailable for use in many wildlife rehabilitation and veterinary setups. Parenteral anaesthetics that are easily available and can be used without any major equipment, like ketamine hydrochloride thus becomes an ideal drug of choice. Ketamine HCl has been used as sole anaesthetic in reptiles for various kinds of interventions ranging from restraint to surgeries (Read 2004; Bennett 1998; Mosley 2005).

The following account is about surgical intervention done in three large bodied snakes, namely, Burmese Python (*Python molurus bivittatus),* King Cobra (*Ophiophagus hannah)* and Banded Krait (*Bungarus fasciatus),* rescued by the MVS unit during Sep–Oct 2015 using ketamine as an anaesthetic agent. Further notes on the use of suture material and post-operative care are also added.

On 11 Sep 2015, a male adult King Cobra was rescued from Lakhipather forest range (Tingrai) with a severe mandibular fracture with an exposed avulsion wound, caused by a train hit injury. A female adult Burmese Python was admitted on 17 Sep 2015 from Saraipung reserve forest of Dehing-Patkai Wildlife Sanctuary. The snake had a severely lacerated deep sheathed injury over the 1/3rd of postero-ventrolateral body due to some unknown reason. The third case, a female adult Banded Krait, was captured on 5 Oct 2015 from a human settlement in Ramnagar of Digboi. The snake had three deep sheathed cut injuries caused by getting trapped in a fishing net. All the three snakes were admitted to the field station of MVS eastern Assam for treatment, care and subsequent rehabilitation back to the wild.

On admission the snakes were measured and weighed, see Table 1 for weight and length. Each snake on admission underwent a detailed examination under physical restraint for the following parameters: 1) Hydration level, HL (based on shine and moistness of scales, from 0/ mild to 2/severe dehydration; 2) Skin texture, ST (from 0/ good to 2/poor); 3) Presence of wounds, W (-/Absent, +/ present); 4) Presence of fracture, F (-/Absent, +/ present); 5) Reflexes, R (from 0/normal to 3/comatose); depending on visual observation 6) Condition of external orifices, EO (1/ Normal. 2/Soiled); 7) Visible mucous membrane, VMM (from 0/normal to 2/pale); and 8) Overall prognosis (0/grave, 1/grave) (Table 2). For administrating the anaesthetics, the snakes were physically restrained and anaesthetized using ketamine hydrochloride (Aneket, 50mg/ml, Neon Laboratories Mumbai, India), IM at caudal musculature, lateral to the spinous processes using 24-gauge needle (Bertelsen 2014) at dosages mentioned in Table 3. The induction time was recorded at the point of reduction of tongue flicking, mild relaxation in

Simple continuous suturing

musculature tone and loss of reflexes to external stimulus; depth of anaesthesia was determined by the complete absence of tongue flicking total relaxation of musculature, fully dilated pupil even on exposure to light and absence of pain and reflexes whereas recovery of anaesthesia was determined by return of tongue flicking, return of muscle tone and alertness and constriction of pupil on exposure to light (Frye 1991). Lavage with ceftriaxone (Intacef, 5 mg/ml, Intas Pharamaceuticals, Ahmedabad, Gujarat, India) mixed in normal saline @250mg/500ml was done for all the wounds of the three snakes before the wounds were painted with povidone iodine (Mader & Bennet 2006).

In the first two cases (king cobra with mandibular fracture and python with deep sheathed injury) the muscles and scales were sutured for wound closure. The scales in both snakes were sutured in simple interrupted pattern with nylon 2-0 (Ethilon, 2-0, Ethicon, Johnson and Johnson, Baddi, Himachal Pradesh, India). Polydioxanone (Vicryl 2-0, Ethicon, Johnson & Johnson, Himachal Pradesh, India) was used to suture the muscles in both cases using a continuous pattern in python and a simple interrupted pattern in king cobra (Mader & Bennet 2006.). The banded krait (with fishing net related deep sheathed injury) when examined, had nylon strings penetrating deep into the muscle. The strings were cautiously released with the help of thumb forceps and scissors and the scales were sutured with nylon 3-0 in a simple interrupted pattern. Post-operative antibiotic coverage was given using ceftriaxone at the dosage of 50mg/kg IM (once daily) for seven days, whereas meloxicam (Melonex, 5mg/ml, Intas Pharmaceuticals Ahmedabad, Gujarat, India) at the dosage of 0.4mg/kg/day was given for three continuous days for post-operative analgesia (Machin 2001). Daily wound dressing and painting with povidone iodine was continued for seven days after which the sutures were removed. The king cobra however, succumbed to its injuries three days post-operatively.

Simple interrupted suturing

Since its discovery in late 1960s ketamine has been used very commonly to anesthetize snakes (Schumacher et al. 1996). In the current study as well, Ketamine was found to be effective in achieving a surgical plane of anaesthesia at dose rate between 20-40 mg/kg body weight. This dose rate is comparable to

Fishing lines line

the results in other studies (Bennet 1998; Spelman et al. 1996; Schildger et al. 1993). Polydioxanone as an internal suture was proved to be effective in preventing any post-operative complication while Ceftriaxone 50 mg/kg body weight was found effective in combating any post-operative infection. Out of the three snakes, Burmese python and banded krait were released back to wild as they recovered uneventfully.

Ketamine at the rate of 12-44 mg/kg for sedation and 55-88 mm/kg for surgical procedures is standardized dose rate for reptiles including snakes. Owing to their slower basal metabolic rate and they being poikilotherms the dosage for anaesthesia is twice the amount used in other endothermic species (like primates) (Beck 1972; Green et al. 1981; Lee et al. 2010; Hayama et al. 1989). However, Ketamine induced anaesthesia/analgesia is highly species dependant (be it ectotherms or endotherms) (Green et al. 1981). The effective dosage significantly depends on core body temperature with lower doses required at lower body temperature but with longer induction and recovery times (Bertelsen *et al*. 2014). Apart from the extended recovery periods, post anaesthetic temperature depression is a common occurrence in many cases of reptiles, especially snakes (Eatewell 2010). Thus maintaining an optimal temperature (preferably close to the preferred optimum temperature zone, POTZ) during the surgical procedure is of utmost importance and methods of preserving body heat. If care is taken to insulate reptile during anaesthesia period, not only recovery can be faster and uneventful, but the wound healing is also better (Varma et al. 1981; Govett et al. 2004).

Wound healing in reptiles is not only dependent on the internal tissue healing

Table 1: Morphometry of rescued snakes

Species	Weight (in Kg)	Length (in cm)		
		Snout-Vent	Tail	Total
Burmese python	7.4	195.072	33.528	228.6
King cobra	3.30	262.128	42.97	305.098
Banded krait	0.275	111.76	11.43	123.19

but is also greatly affected by the suture material used. Thus it is imperative to use a material that will cause the minimum amount of tissue reaction and provide the most secure wound closure. The overall process of wound healing in reptiles is even though similar to that in mammals, its much slower and has some unique characteristics. The lack of proteolytic enzymes in the reptilian neutrophils lead to slow or sometimes negligible absorption of the suture material (McFadden et al. 2011). This is more pronounced in cases of suture materials like Chromic catgut, the absorption of which is dependent on proteolysis and also associated with higher tissue reaction and poor relative knot security (Di Girolamo & Mans 2016). Absorbable suture material like polydioxanone, polyglycolic acid, polyglactin 910, etc. are thus recommended suture materials in case of reptile surgery (Bennett 1998). The current study as well, the use of polydioxanone was found to be effective in achieving wound closure and healing before the reptile was released back in the wild.

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Removing of fishing lines

Table 2: Clinical examination of rescued snakes

Case	Species	HL	ST	W	F	R	EO	VMM	P
1	Burmese Python	0	0	+	-	0	1	0	0
2	King Cobra	2	1	+	+	0	1	2	1
3	Banded Krait	0	0	-	+	0	1	0	0

Released Python

to commonly used suture materians in the skin and musculature of ball pythons (*Python regius). American Journal of Veterinary Research* 72(10): 1397–1406.
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Table 3: Induction, dose, depth and recovery data sheet

Case	Species	Dose (mg/Kg)	Induction (minutes)	Anaesthetized (minutes)	Recovery (minutes)
1	Burmese Python	20	7.45	12	360
2	King Cobra	30	6	9	240
3	Banded Krait	40	7	8	420

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