

Table 1: The admission of patients with snakebite injuries during the period of October 2012-October 2013

Year	Month	In patient snake bite		ASV given	Death	Referred to plastic surgery	
		Adult	Pediatrics			Pediatrics	Adult
2012	October	23	3	10	1	1	4
2012	November	16	2	8	2	0	1
2013	December	15	5	5	1	1	1
2013	January	10	1	3	1	0	2
2013	February	16	2	9	2	0	4
2013	March	9	4	7	2	0	1
2013	April	11	7	10	1	1	4
2013	May	44	8	34	3	1	5
2013	June	119	2	22	0	1	4
2013	July	22	2	20	0	0	4
2013	August	27	1	20	2	1	5
2013	September	19	3	15	0	0	2
2013	October	20	4	11	2	1	3
Total	13 months	351	44	174	17	7	40
Number of patients		395				47	

ASV: anti-snake venom

Table 2: The number of pediatric and adult patients referred to plastic surgery department with snake bite injuries

	Cellulitis		Compartment syndrome		Surgery	
	Upper limb	Lower limb	Upper limb	Lower limb	Upper limb	Lower limb
<i>n</i>	6	17	2	5	7	10
Paediatrics	1	1	0	1	1	2
Adult	5	16	2	4	6	8
Total	23		7		17	

bleeding, hypotension, cardiotoxicity, and nephrotoxicity that require immediate medical attention. Local signs such as tissue edema, compartment syndrome, and tissue necrosis increases the morbidity and may result in fasciotomy or amputation of the involved extremity.^[7,8]

ASV administration can reduce progression of the initial tissue damage, but it cannot reverse local tissue damage such as tissue edema, inflammation, compartment syndrome, and necrosis.^[7] Although inflammation induced by snake envenomation often mimics infection, true bacterial cellulitis is uncommon, and only affects 3% of snakebites.^[9] Tissues at the point of envenomation may be nonviable regardless of intervention. The adjacent zone consists of variably injured tissues that may recover if the process of inflammation is reduced. Most therapeutic maneuvers are focused on this penumbra of tissue, in an attempt to maximize recovery of the injured marginal tissue. Finally, an outer zone of minimally injured tissues that are not subject to primary injury may be at risk from the processes of secondary injury resulting from the delayed, physiological inflammatory responses to snake bite injury. Occasionally, the quantity of tissue loss and destruction caused by secondary injury can dwarf the actual loss from the primary snakebite. Hence, there is a need for modalities that impede the progress of inflammation, preserve marginal tissue at risk, and prevent ischemic advancement of the injured tissue.

When compartment syndrome occurs in snakebite injuries, there is controversy as to whether or not fasciotomy is required. Snakebite injuries can produce pain, swelling, induration, paresthesias, color changes, absent pulses,



Figure 1: (a) Compartment syndrome right leg and foot lateral view; (b) compartment syndrome right leg and foot medial view; (c) six sessions following hyperbaric oxygenation therapy

and tenderness in the envenomated extremity, mimicking the initial signs of compartment syndrome. However, true compartment syndrome is much less common.^[10] In a case series conducted by Tanen *et al.*,^[11] only 8/236 (3.4%) of patients received a fasciotomy or digital dermatomy for compartment syndrome. Measurement of compartment pressures prior to fasciotomy is always recommended. Recent literature indicates that an increase of intracompartmental pressures of up to 30-45 mmHg is an absolute indication for fasciotomy.^[12,13] Unfortunately, measurement of intracompartmental pressure is not always possible in a number of medical centers in India, and most of the diagnoses of compartment syndrome are made on clinical grounds alone. Anz *et al.*^[14] reported that 21.2% of all poisonous snake bites involve fingers. Fingers have small compartments with its small diameters, and the elastic limit of the skin can be rapidly reached. Compartment pressure measurement may not be feasible in cases of digital envenomation, and the diagnosis of compartment syndrome can only be made on clinical grounds.^[15] Some authors support early fasciotomy in the treatment of all cases of snake bite envenomation.^[15,16] Fasciotomies are not without complication, and may result in disfiguring scars, contractures, nerve damage, leading to significantly lengthening of treatment.^[7]

Table 3: The number of pediatric and adult patients referred to plastic surgery department with snake bite injuries subjected to surgical intervention

Age (years)/ gender	Upper limb		Lower limb		Surgery
	Pediatric	Adult	Pediatric	Adult	
22/male		Right thumb			Terminalization
28/female		Right-hand dorsum			Debridement and groin flap cover
32/male		Right index finger			Terminalization
8/male			Right foot dorsum		Debridement and skin grafting
50/male				Right second toe	Terminalization
45/male				Right leg lower 3rd lateral aspect	Debridement and ALT free tissue transfer
25/male	Left middle finger			Left 4th toe	Terminalization
7/male					Terminalization
32/female		Right index finger MPX level			Debridement and cross finger flap
10/male			Left foot dorsum		Debridement and skin grafting
26/male				Right foot dorsum	Debridement and skin grafting
34/female		Right ring fingertip region			Debridement and cross finger flap
35/female				Right foot dorsum	Debridement and lateral supramalleolar flap cover
22/male				Left foot great toe	Terminalization
47/male				Left leg middle 3rd lateral aspect	Debridement and skin grafting
32/male				Left foot little toe	Terminalization
27/female		Right thumb dorsal aspect			Debridement and FDMA flap

ALT: anterolateral thigh; MPX: middle phalanx; FDMA: first dorsal metacarpal artery



Figure 2: (a) Day 1 following snake bite injury; (b) day 2 following hyperbaric oxygenation therapy; (c) day 3 following hyperbaric oxygenation therapy; (d) day 5 following hyperbaric oxygenation therapy; (e) wound following debridement and grafting

HBO therapy may reduce the penumbra of cells at risk for delayed necrosis and secondary ischemia in snakebite injury patients with early compartment syndrome,^[15] breathing of 100% oxygen under increased ambient pressure prevents reperfusion injury, reduces tissue edema, and reverses sublethal tissue damage.^[15,16] Vasoconstriction reduces edema and tissue swelling while ensuring adequate oxygen delivery in snakebite wounds.

In our series, 23 patients were treated for cellulitis and 7 patients for compartment syndrome. In our experience, HBO therapy is a helpful tool when there is an impending compartment syndrome that may require a fasciotomy



Figure 3: (a) Soft tissue defect right leg and ankle region; (b) anterolateral thigh free tissue transfer done for the soft tissue defect

later. We did not experience any complications related to HBO therapy in our series. It is difficult to be certain whether in the absence of HBO our patients treated with snake envenomation injuries would have progressed to compartment syndrome or tissue necrosis.

As the degree of cellulitis and its severity varied from patient to patient as did the timings of the referrals, there was no standardized starting point for HBO therapy. Six sessions are minimum given to attain a tangible decrease in swelling. Assessment of sensory loss may not be possible in small children, and hence we determine the treatment endpoint based on the decrease in girth of the limb and also the movement of the toes. HBO therapy after surgical debridement, skin grafting or flap reduces edema of the inflamed operation site. Hence, we

