Venomics of *Bungarus caeruleus* (Indian krait): Comparable venom profiles, variable immunoreactivities among specimens from Sri Lanka, India and Pakistan

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**Abstract**

The Indian krait (*Bungarus caeruleus*) is one of the “Big four” venomous snakes widely distributed in South Asia. The present venomic study reveals that its venom (*Sri Lankan origin*) is predominated by phospholipase A2 (64.5% of total proteins), in which at least 46% are presynaptically-acting β-bungarotoxin A-chains. Three-finger toxins (19.0%) are the second most abundant, comprising 15.6% k-neurotoxins, the potent postsynaptically-acting long neurotoxin. Comparative chromatography showed that venom samples from Sri Lanka, India and Pakistan did not exhibit significant variation. These venoms exhibited high immunoreactivity toward VINS Indian Polyvalent Antivenom (VPV). The Pakistani krait venom, however, had a relatively lower degree of binding, consistent with its moderate neutralization by VPV (potency = 0.3 mg venom neutralized per ml antivenom) while the Sri Lankan and Indian venoms were more effectively neutralized (potency of 0.44 mg/ml and 0.48 mg/ml, respectively). Importantly, VPV was able to neutralize the Sri Lankan and Indian venoms to a comparable extent, supporting its use in Sri Lanka especially in the current situation where Sri Lanka-specific antivenom is unavailable against this species. The findings also indicate that the Pakistani *B. caeruleus* venom is immunologically less comparable and should be incorporated in the production of a pan-regional, polyvalent antivenom.

**Keywords:**
- Indian krait
- *Bungarus caeruleus*
- Venomics
- Antivenom neutralization

1. Introduction

Venoms are arsenal of natural toxins, representing a critical adaptive trait in the advanced snakes [1,2]. The compositions and immunological profiles of snake venoms are known to vary between species, nonetheless, intra-specific evolvability and variability of venom composition have been increasingly appreciated for the impacts on basic research, phylogenetics and management of snakebite envenomation [3–5]. Geographical locality of the snake has been proposed as a major factor of intraspecific venom variability, presumably driven by differences in the diet/prey between geographical populations [6–8].

Consequently, the toxic profile and clinical manifestation of snakebite envenomation can vary geographically, even though the lures are inflicted by the same species [4,7,3,10]. The phenomenon is often