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A Clinical Comparison of the Effect of Spinal Anaesthesia in Patients with History of Scorpion Bite(s) and Negative History of Scorpion Bite

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ABSTRACT

Background: Scorpion envenomation is known to cause long-term alterations in autonomic and peripheral nerve function, potentially affecting the pharmacodynamic response to local anaesthetic agents. Several clinical reports suggest delayed or inadequate spinal anaesthesia in individuals with a prior history of scorpion sting. However, systematic clinical evidence remains limited. This study compared spinal anaesthesia characteristics between patients with and without a history of scorpion sting.

Methods: This prospective observational study included 40 ASA I–II patients aged 18–70 years undergoing elective infra-umbilical surgeries under spinal anaesthesia. Patients were divided into two groups: Group S (history of ≥1 scorpion sting) and Group C (no sting history), 20 in each group. All patients received 3.2 mL of 0.5% hyperbaric levobupivacaine intrathecally. Onset of sensory block, onset of motor block, time to peak sensory block, and time to peak motor block were assessed. Repeat spinal attempts, number of stings, and duration since sting were also analysed. Statistical significance was set at $p < 0.05$.

Results: Demographic variables were comparable between groups. Group S demonstrated significantly delayed onset of sensory block (2.55 ± 0.60 min vs. 1.50 ± 0.52 min) and motor block (3.55 ± 0.60 min vs. 2.50 ± 0.52 min) compared with Group C ($p < 0.001$). Time to peak sensory block (6.65 ± 0.48 min vs. 4.95 ± 0.51 min) and peak motor block (7.65 ± 0.48 min vs. 5.95 ± 0.51 min) was also significantly prolonged in Group S ($p < 0.001$). Four patients in Group S required repeat spinal anaesthesia; none in Group C required repeat or general anaesthesia. The number of stings showed no significant influence on block characteristics; however, a duration <5 years since sting was associated with significantly longer onset and peak block times ($p < 0.05$).

Conclusion: Patients with a prior history of scorpion sting exhibit delayed onset and prolonged peak effects of spinal anaesthesia, likely due to persistent venom-induced autonomic or ion-channel alterations. Anaesthesiologists in endemic regions should consider recent sting history as a potential risk factor for altered neuraxial block behaviour.

Keywords: *Scorpion sting, spinal anaesthesia, autonomic dysfunction, levobupivacaine, regional anaesthesia, neurotoxins.*

INTRODUCTION

Scorpion envenomation remains an important public health concern in many tropical and subtropical regions, placing nearly two billion people at risk and contributing to over one million cases annually, particularly in Africa, the Middle East, India, Mexico, and Brazil.[1] More than 2,700 species across 20 families have been identified, with the smaller and slender-pincered species often being the most venomous. Although many stings lead only to localized pain, systemic

toxicity may occur, especially among children and elderly individuals, manifesting as autonomic dysfunction, respiratory compromise, pulmonary edema, and cardiogenic shock.[2] The severity of envenomation depends on factors such as venom load, age, season, and time to treatment and is commonly categorized using Abroug's severity classification.[3]

The incidence of scorpion stings is high in regions such as North Africa, Latin America, the Middle East, and India.[4] Of the 86 reported scorpion species in India, Mesobuthus tamulus and Heterometrus swammerdami are of greatest medical relevance. A growing number of case reports and studies suggest that individuals with a history of scorpion sting may experience reduced sensitivity to local anaesthetic agents, often recognized after incomplete or failed spinal blocks.[5] Scorpion neurotoxins act primarily on voltage-gated sodium channels, prolonging depolarization and disturbing nerve conduction, which may interfere with the pharmacodynamic response to local anaesthetics.[6] Regional anaesthesia, particularly spinal anaesthesia, plays a critical role in perioperative care and Enhanced Recovery After Surgery (ERAS) protocols.[7] However, failure of spinal block can occur due to technical difficulties, anatomical variations, inadequate intrathecal spread, or true drug resistance. Recent reports describe delayed onset, partial sensory or motor block, or complete failure of spinal anaesthesia among patients with prior scorpion envenomation receiving standard intrathecal bupivacaine.[5,8]

These observations raise concern regarding potential long-term neurotoxic alterations in ion channel function or autonomic regulation. Despite these reports, evidence remains limited, and there is a lack of systematic clinical evaluation comparing spinal block characteristics in patients with and without a history of scorpion sting. Therefore, the present study aimed to compare the onset, progression, and adequacy of spinal anaesthesia in patients with a previous scorpion sting and those without such history.

AIM OF THE STUDY

To compare the effect of spinal anaesthesia in groups of patient with positive history of scorpion bite and negative history of Scorpion bite.

OBJECTIVES OF THE STUDY

1. To evaluate the onset and duration of sensory and motor block following spinal anaesthesia in both groups.
2. To evaluate the effects on spinal anaesthesia in both groups of patients with duration and numbers of scorpion bites.
3. To study the factors affecting effect on spinal anaesthesia in both groups.

MATERIAL AND METHODS

This hospital-based comparative cross-sectional study was conducted at the Indian Institute of Medical Science and Research, Jalna, between June 2023 and December 2024, after obtaining approval from the Institutional Ethics Committee and the Maharashtra University of Health Sciences (MUHS), Nashik. Adult patients aged 18–70 years, belonging to ASA physical status I or II and scheduled for elective infra-umbilical surgery under spinal anaesthesia, were screened for eligibility. Patients with a history of asthma or airway disease, cardiac, renal, hepatic, or neurological disorders, obesity, pregnancy, or those unwilling to participate were excluded. Based on data from Archana et al.[9] the calculated sample size was 16.8 participants per group; however, 40 patients were ultimately enrolled, with 20 allocated to each group using simple random sampling. Group S included patients with a previous history of one or more scorpion stings, and Group C consisted of patients without any such history. All participants underwent a standard pre-anaesthetic evaluation, including detailed history, physical and systemic examination, airway assessment, spine examination, and routine investigations. Patients were kept fasting overnight, and informed written consent was obtained in their native language.

In the operating room, baseline heart rate, non-invasive blood pressure, respiratory rate, and oxygen saturation were recorded, and an 18-G intravenous cannula was inserted for Ringer lactate infusion. Under full aseptic precautions, spinal anaesthesia was administered at the L3–L4 interspace using a 25-G Quincke needle. After confirming free cerebrospinal fluid flow, 3.2 mL of 0.5% hyperbaric levobupivacaine was injected intrathecally, and patients were positioned supine. Standard intraoperative monitoring, including ECG, NIBP, and SpO_2, was continued throughout the procedure. Block characteristics were assessed using predefined time points: T0 (time of injection), T1 (onset of sensory block), T2 (onset of motor block), T3 (peak sensory block), and T4 (peak motor block). Sensory block was assessed using a pin-prick method, with onset defined as loss of pain sensation at T10 and peak defined as the highest cephalad level achieved without further progression. Motor block was evaluated every two minutes using the modified Bromage scale.[8] Onset was defined as the inability to flex the hip, and peak motor block as the highest stable level attained. If an adequate block (T6–T8) was not achieved within 20 minutes, a repeat spinal attempt was made; persistent inadequacy prompted conversion to general anaesthesia. Postoperatively, all patients were monitored in the PACU for 24 hours.

Data were entered and coded in Microsoft Excel and analyzed using SPSS version 26. Continuous variables were presented as mean ± standard deviation, while categorical variables were summarised as frequencies and percentages.

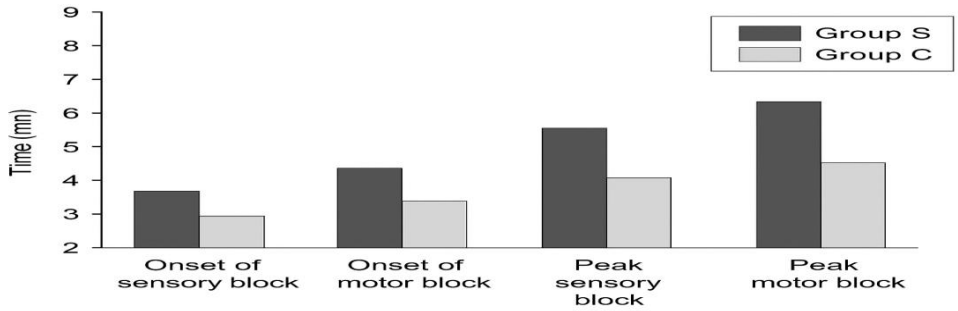
Group comparisons were performed using the unpaired t-test for continuous variables and the Chi-square test or Fisher's exact test for categorical variables, with a p-value <0.05 considered statistically significant.

RESULTS

A total of 40 patients were included in the study, with 20 patients in Group S (with a history of scorpion sting) and 20 patients in Group C (without such history). The demographic characteristics were comparable across both groups. The mean age was 43.7 ± 16.05 years in Group S and 41.7 ± 15.44 years in Group C, with male predominance observed in both groups. Most participants in each group belonged to rural regions, and the distribution of ASA physical status (I and II) was also similar, showing no statistically significant differences between groups. (Table No. 1)

Table 1. Baseline Characteristics of Study Participants (N = 40)				
Variable		Group S (n=20)	Group C (n=20)	p-value
Age (years), mean ± SD		43.7 ± 16.05	41.7 ± 15.44	0.69
Gender	Male	16	12	0.16
	Female	4	8	
Region	Rural	15	12	0.3
	Urban	5	8	
ASA	I	14	11	0.32
	II	6	9	

Marked differences were observed in spinal block characteristics. Patients in Group S demonstrated significantly delayed onset and peak times for both sensory and motor blockade when compared with Group C. (Fig No. 1)



The mean onset of sensory block was 2.55 ± 0.60 minutes in Group S versus 1.50 ± 0.52 minutes in Group C, while onset of motor block was 3.55 ± 0.60 minutes versus 2.50 ± 0.52 minutes, respectively. Time to peak sensory block (6.65 ± 0.48 vs. 4.95 ± 0.51 minutes) and peak motor block (7.65 ± 0.48 vs. 5.95 ± 0.51 minutes) was also significantly longer in Group S ($p < 0.001$ for all comparisons). Repeat spinal anaesthesia was required in four patients, all of whom belonged to Group S; no patient in either group required conversion to general anaesthesia. (Table No. 2)

Table 2. Comparison of Spinal Block Characteristics Between Groups			
Parameter (min)	Group S (mean ± SD)	Group C (mean ± SD)	p-value
Onset of sensory block	2.55 ± 0.60	1.50 ± 0.52	<0.001*
Onset of motor block	3.55 ± 0.60	2.50 ± 0.52	<0.001*
Peak sensory block	6.65 ± 0.48	4.95 ± 0.51	<0.001*
Peak motor block	7.65 ± 0.48	5.95 ± 0.51	<0.001*

*Significant ($p < 0.05$)

Within Group S, 80% had experienced a single sting and 20% multiple stings, but the number of stings did not significantly influence sensory or motor block characteristics. However, duration since the sting showed a statistically significant effect. Patients with sting history <5 years demonstrated prolonged onset and peak times compared to those with a sting history >5 years ($p < 0.05$), suggesting a greater physiological impact of recent scorpion envenomation on responsiveness to local anaesthetic agents. (Table No. 3)

Table 3. Influence of Sting Number and Duration on Block Characteristics (Group S Only)						
Variable	Single Sting (n=16)	Multiple Stings (n=4)	p-value	Sting <5 years (n=3)	Sting >5 years (n=17)	p-value
Onset of	2.56 ± 0.63	2.50 ± 0.57	0.85	3.33 ± 0.57	2.41 ± 0.50	0.01*

sensory block						
Onset of motor block	3.56 ± 0.63	3.50 ± 0.57	0.85	4.33 ± 0.57	3.41 ± 0.50	0.01*
Peak sensory block	6.75 ± 0.44	6.25 ± 0.50	0.06	7.33 ± 0.57	6.58 ± 0.50	0.03*
Peak motor block	7.75 ± 0.44	7.25 ± 0.50	0.06	8.33 ± 0.57	7.58 ± 0.50	0.03*

*Significant ($p < 0.05$)

DISCUSSION

In this comparative cross-sectional study, patients with a previous history of scorpion sting demonstrated significantly altered spinal anaesthetic characteristics compared with those without such history. Although the demographic variables, including age distribution, gender profile, region of residence, and ASA physical status, were comparable between the two groups, marked differences were observed in the pharmacodynamic response to intrathecal levobupivacaine. Patients in the sting-exposed group exhibited a distinctly slower onset of both sensory and motor block, as well as prolonged time to peak block. Four individuals also required repeat spinal attempts, whereas none in the control group showed inadequate block. These findings suggest a persistent physiological impact of scorpion envenomation on neural function.

The delayed and attenuated response to spinal anaesthesia in previously stung patients aligns closely with earlier reports by Panditrao et al. and Kosam et al., who documented block resistance and delayed onset following prior scorpion envenomation.[8,10] The mechanism is biologically plausible. Scorpion venom particularly from Mesobuthus tamulus, the predominant medically significant species in India—contains a complex spectrum of neurotoxins that act mainly on voltage-gated sodium and potassium channels.[11-13] These toxins delay sodium channel inactivation, promote prolonged neuronal depolarization, and trigger a sustained autonomic storm.[14] Even after clinical recovery, several studies have shown subclinical autonomic dysfunction and altered nerve conduction persisting for months to years.[11,15] This persistent channelopathy or autonomic dysregulation likely alters the interaction between local anaesthetics and neural membranes, thereby reducing the efficacy or delaying the onset of spinal block.[16]

Our results are also consistent with studies evaluating neuraxial block in patients with autonomic instability. Goyal et al. and Kale et al. demonstrated exaggerated cephalad spread and prolonged block duration in individuals with autonomic dysfunction, findings that parallel the behaviour observed in our scorpion sting group.[17,18] Similar patterns have been reported in patients with diabetic autonomic neuropathy, further reinforcing that sympathetic imbalance modifies spinal anaesthetic spread and onset.[19] Post-envenomation inflammatory alterations in neural and connective tissues may additionally influence cerebrospinal fluid dynamics, drug distribution, or receptor sensitivity.[20] These mechanisms collectively support the prolonged onset and heightened block intensity seen in the sting-exposed population.

The subgroup analysis revealed that the number of previous stings did not significantly alter spinal block characteristics, but the duration since sting did. Patients with a history of sting less than five years prior exhibited more pronounced delays in onset and peak block, indicating that the recency of envenomation is more relevant than the total number of exposures. Similar observations were described by Panditrao et al., who reported higher risk of block failure in individuals with recent stings.[8] Long-term autonomic consequences of scorpion envenomation have been documented, with reports of exaggerated cardiovascular responses up to three decades after the sting.[11] This underscores the need for heightened vigilance during neuraxial anaesthesia in this patient population. Case evidence suggesting resistance to local anaesthetics after even a single sting further supports the possibility of venom-induced channel modulation.[19] Recent recommendations from Fernandes et al. and de Oliveira et al. advocate an expanded autonomic assessment before major surgeries in patients from endemic regions, a practice that may be beneficial where scorpion stings are common.[21,22]

CONCLUSION

In our study, it was found that

1) Time taken for the onset of the sensory block in group S (2.55 ± 0.60 min) as compared to group C (1.5 ± 0.52 min) is prolonged. The patient having history of scorpion bite, time taken for onset of the sensory blockade is experienced prolonged as compared to the patient having negative history of scorpion bite.

2) Time taken for the onset of motor blockade in group S (3.55 ± 0.60 min) as compared to group C (2.5 ± 0.52 min) is prolonged . The patient having history of scorpion bite, time taken for onset of motor blockade is experienced prolonged as compared to the patient having negative history of scorpion bite.

3) Time taken for peak of sensory blockade in group S (6.65 ± 0.48 min) as compared to group C (4.95 ± 0.51 min) is prolonged . The time taken for peak of sensory block is prolonged in patient having history of scorpion bite as compared to patient having negative history of scorpion bite.

4) Time taken for peak of motor blockade in group S (7.65 ± 0.48 min) as compared to group C (5.95 ± 0.51) is prolonged . The time taken for peak of motor blockade is prolonged in patient having history of scorpion bite as

compared to negative history of scorpion bite. This is likely due to lingering neurotoxic effects on the autonomic and peripheral nerves. Routine anaesthesia protocols may need to be change for these patients. More research is required to examine neurophysiological changes and improve anaesthesia management in individuals after envenomation. Always ask past history of scorpion sting prior to sugery in all patients in regions where scorpion sting is common.
Final conclusion is that "SCORPION BITE DEFINITELY AFFECTS THE SPREAD OF SPINAL BLOCK BY NEUROTOXIC INVENOMATION".

DECLARATION

Conflicts of interests: The authors declare no conflicts of interest.
Author contribution: All authors have contributed in the manuscript.
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