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7 **Efficacy of Ropivacaine for Sub-Arachnoid Block in Patients with Recent**
8 **History of Scorpion Sting**

9 *A case series*

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16
17 **Abstract**

18 Failure of sub-arachnoid block (SAB), due to resistance to bupivacaine after a recent scorpion
19 sting can lead to multiple block attempts and subsequent conversion to general anaesthesia.
20 We report this case series of 10 patients with successful SAB with newly launched 0.75%
21 hyperbaric ropivacaine, in patients with recent scorpion sting. Thus, intrathecal hyperbaric
22 ropivacaine may be considered as the local anaesthetic agent of choice in patients with
23 scorpion sting to prevent failure of SAB.

24 **Keywords:** Bupivacaine; Ropivacaine; Scorpion sting; Spinal anaesthesia

25
26 **Introduction**

27 Spinal anesthesia or Sub-arachnoid block (SAB) is a commonly practised technique of
28 anaesthesia for most below-umbilical procedures.¹ Clinical data has shown a correlation
29 between previous history of scorpion sting and resistance to SAB with bupivacaine, an
30 amino-amide local anaesthetic.^{2,3}

31
32 Ropivacaine (2,6-dimethylphenyl, 1-propylpiperidine,2-carboxamide) is a piperidine-
33 carboxamide- based amide, prepared as pure S-enantiomer.⁴ Multiple studies have shown that

34 ropivacaine is a safe and effective local anesthetic (LA) for regional anaesthesia techniques.
35 Hyperbaric preparation of ropivacaine (0.75%) for SAB have recently been launched in India,
36 and its efficacy and safety for intra-thecal administration has been documented.⁵

37

38 We report successful sub-arachnoid blockage with ropivacaine in patients with confirmed
39 history of recent scorpion sting.

40

41 **Case series**

42 This case series includes 10 patients of either gender, aged 18-70 years, with a history of
43 scorpion sting within 5 years, undergoing below umbilical surgeries under SAB, between
44 August 2022 and November 2022 at a tertiary care hospital of central India [Table 1].

45 Patients with confirmed history of scorpion sting in pre-anaesthetic check-up , were further
46 evaluated for the number of stings, duration since last sting and severity of the sting [Grade
47 1- local pain & paraesthesia at the sting site, Grade 2- local pain and paraesthesia existing at
48 the sting site as well as proximal to the sting site, Grade 3- Grade 2 factors with added cranial
49 nerve (increased oral secretions, blurry vision, rapid tongue movement, nystagmus), or
50 skeletal neuromuscular dysfunction (flailing of the extremities and tetanus-like arching of the
51 back) with or without autonomic dysfunction, Grade 4- includes both cranial nerve and
52 skeletal muscle dysfunction, hyperthermia, rhabdomyolysis, pulmonary oedema, multiple
53 organ failures].⁶

54

55 A written-informed consent was obtained from all the patients for publication purposes. After
56 standard fasting of 8 hours, patients were shifted to operation theatre and standard monitors
57 applied and baseline vitals were noted. A single operator performed all the SAB, using 25
58 gauze, 90 mm Becton Dickinson (BD), Quinke needle, at L₃₋₄ interspace in the sitting
59 position, with a standard dose of 3.2 mL, 0.75% hyperbaric ropivacaine. The patients were
60 positioned supine immediately after drug administration and assessment for autonomic,
61 sensory, and motor blockage was done by a blinded observer (trained anesthesiologist)
62 immediately after supine positioning.

63

64 Haemodynamic parameters were noted every minute for 5 minutes from the time of supine
65 positioning, and every 5 minutes afterwards for 20 minutes.

66

67 Sensory blockage was assessed using pin-prick method, using a two-point scoring system (0-
68 normal sensation, 1- loss of pain sensation but pressure sensation intact, 2 – loss of pain &
69 pressure sensation). A score of 1 and 2 at T10 level, were considered as onset and completion
70 of sensory block, respectively.

71

72 Bromage scale⁷ was used for motor blockage assessment. Bromage grade II and IV were
73 considered as onset and completion of motor block, respectively. The block was considered
74 adequate when a complete sensory and motor blockage was achieved at T-10 level, and
75 planned surgery was started. In case of inadequate blockage (a sensory score of 0 or 1 with
76 Bromage grade < IV) at 20 minutes after SAB, it was considered a block failure. On the
77 completion of surgery, patients were shifted to post-anaesthesia care units for monitoring.
78 The time for onset and completion of sensory and motor blockage, and block failure were
79 assessed for association with number, duration, and severity of sting.

80

81 **Results**

82 The mean time to onset of sensory and motor block was 78.8 and 94.2 seconds respectively,
83 and the mean time to completion of sensory and motor blockage was 117 and 146.7 seconds
84 respectively. All 10 patients achieved complete sensory and motor blockage within 20
85 minutes and none of the SAB failed.

86

87 Out of 10 patients, 5 patients had a history of single sting, 3 patients had 2-5 stings and 2
88 patients >5 stings. The mean time to onset and completion of sensory and motor blockage
89 was more in patients with history of multiple (>2) stings (Figure 1-A). Patients with sting
90 within one year had relatively faster onset of sensory and motor block as compared to
91 patients with sting between 1 to 5 years (Figure 1-B). Patients with clinical grade 2 and 3
92 sting had relatively delayed onset and completion of blockage (Figure 1-C). No episode of
93 post-spinal hypotension (fall in Mean Arterial Pressure (MAP) > 20% from baseline) was
94 observed in our patients, except patient 4 (Figure 2).

95

96 **Discussion**

97 Scorpion sting is a common occurrence in Indian sub-continent. Usually harmless, with
98 manifestations like severe pain, and burning sensation at the site of sting. Systemic
99 manifestations like myocardial infarction, acute pulmonary oedema, cardiogenic shock and

100 death are very rare.⁸ Thus, a large rural population coming for elective surgical procedures,
101 may give history of grades 1 or 2 sting.⁶

102

103 The scorpion venom is a weak acid (pH 6.5) and highly complex mixture of salts,
104 nucleotides, biogenic amines, enzymes, mucoproteins, and neurotoxins, acting on ion
105 channels specifically voltage gated sodium channels (VGSC). Out of various scorpion toxins,
106 alpha and beta toxins are known to bind to mammalian VGSC. The alpha toxin binds
107 extracellularly to S3-S4 loop in domain IV and extracellular part of segment S5-S6 of domain
108 I.⁹ The beta toxin binds to extracellular part of segment 4 of domain II.⁹ The binding site of
109 local anesthetics (LA) is segment 6 of domain IV of alpha subunit of VGSC.¹⁰ Panditrao et
110 al.^{2,3} had described the resistance to intrathecal bupivacaine in patients with a history of
111 scorpion sting, and postulated that scorpion toxin itself or the antibodies against the toxin are
112 responsible for the development of resistance to intrathecal bupivacaine.

113

114 Amrita et al.¹¹ demonstrated adequate sensory and motor block after SAB with 0.75%
115 hyperbaric ropivacaine in 2 patients with a history of scorpion sting with documented
116 resistance to bupivacaine on subcutaneous LA testing. Similarly, the present case series
117 demonstrated successful sub-arachnoid block with 0.75% hyperbaric ropivacaine in 10
118 patients with a history of scorpion sting. Out of 10 patients, 5 patients had a history of single
119 sting, 3 patients had 2-5 stings and 2 patients >5 stings. The mean time to onset and
120 completion of sensory and motor blockage was more in patients with history of multiple (>2)
121 stings as compared to single sting. This may be due to the antibodies against scorpion venom
122 that had accumulated with multiple stings as postulated by Panditrao et al.^{2,3}

123 Patients with sting history between 1-5 years had comparatively delayed onset and
124 completion of sensory and motor blockage as compared to patients with a sting within 1 year.
125 Patients with clinical grade 2 and 3 sting had relatively delayed onset and completion of
126 sensory and motor blockage.

127

128 Molecular modelling of local anesthetic binding with VGSC has demonstrated the differences
129 in the relative alignment of aromatic part of ropivacaine as compared to other LA on VGSC.
130 The aromatic part of ropivacaine aligns towards the outer side of VGSC whereas the aromatic
131 part of bupivacaine aligns towards the inner side of the channel.^{12,13} This differential
132 alignment of aromatic ring may contribute to the difference in resistance of the two LA
133 caused by scorpion sting. Further, action of ropivacaine on gamma aminobutyric acid A

134 (GABA-A) and N-methyl-D-aspartate (NMDA) receptors,^{14,15} facilitates its LA action,
135 thereby decreasing the chances of its resistance in patients with a scorpion sting. Thus,
136 differences in the three-dimensional structures of ropivacaine and bupivacaine may confer
137 differences in the activity of their enantiomers in the complex biological environment of the
138 receptors,⁴ and may be responsible for the success of intra-theal ropivacaine in patients with
139 scorpion sting.

140

141 **Conclusion**

142 Intrathecal hyperbaric ropivacaine may be considered as the local anaesthetic agent of choice
143 in patients with scorpion sting to prevent failure of sub-arachnoid block. Further scientific
144 studies are needed to further validate these findings.

145

146 **Authors' Contribution**

147 Concept and design of study was made by ST. ST, HB, TKS and SG were involved in
148 defining intellectual content, literature search, data acquisition, data analysis, statistical
149 analysis, manuscript preparation, manuscript editing, and manuscript review of the article.
150 All authors approved the final version of the manuscript.

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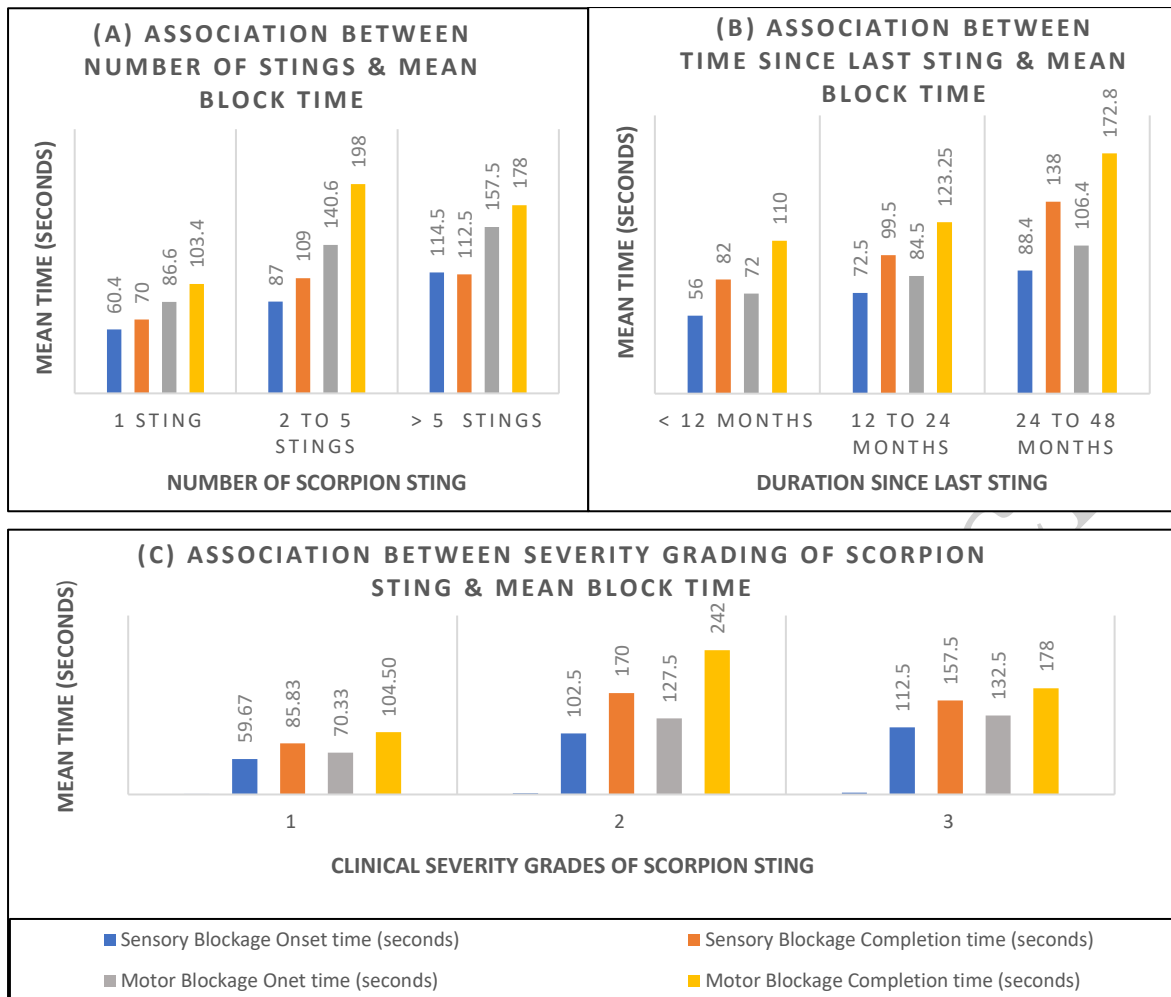
186 **Table 1:** Demographic profile & Block parameters

Age (years)	Gender	ASA-PS	Surgery	Number of times of Scorpion sting	Number of stings in past 5 years	Duration since last sting (months)	Severity of sting with Clinical Grade	Sensory blockage Onset / Completion (seconds)	Motor blockage Onset / Completion (seconds)
38	Female	1	Fistulectomy	1	1	48	Mild / 1	80 / 135	85 / 140
62	Male	2	Right inguinal hernia repair	1	1	42	Mild / 1	65 / 90	82 / 120
38	Male	1	Left femur external fixation	3	2	4	Mild / 1	56 / 82	72 / 110
70	Female	2	Right Proximal Femur Nailing	1	1	12	Mild / 1	39 / 50	55 / 67
58	Male	2	Right inguinal hernia repair	6	3	18	Moderate / 2	94 / 140	70 / 166
26	Male	1	Left inguinal hernia repair	1	1	16	Mild / 1	46 / 68	48 / 70
56	Male	2	Rt inguinal hernia repair	1	1	44	Mild / 1	72 / 90	80 / 120

50	Male	1	End to end urethrop lasty	6	3	48	Severe / 3	135 / 175	155 / 190
56	Male	2	Right Inguinal hernia repair	2	2	22	Moderate / 2	115 / 140	125 / 190
55	Male	2	Right Inguinal hernia repair	4	2	48	Moderate / 2	90 / 200	130 / 294

187 ASA-PS – American Society of Anesthesiologists Physical Status.

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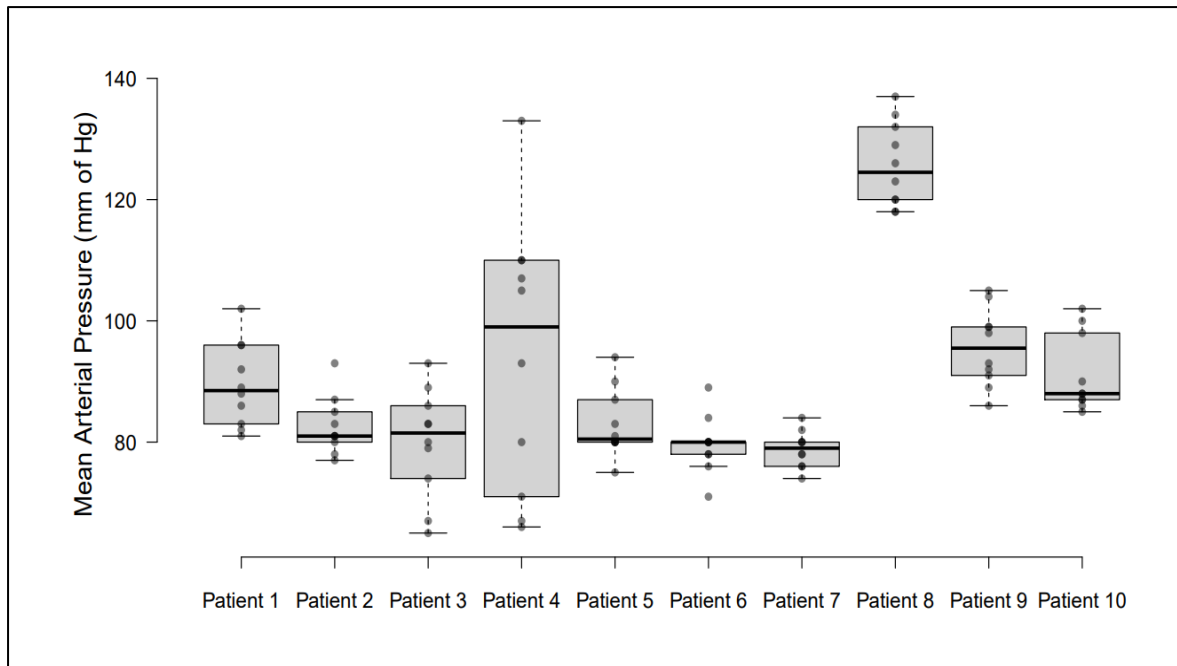
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190 **Figure 1: A)** Association between Number of Scorpion Stings and Mean block Time, **B)**

191 Association between Duration since last Scorpion Sting and Mean block Time, **C)** Association

192 between Clinical Severity Grade of Scorpion Sting and Mean block Time.

193



194

195

Figure 2: Variation of Mean Arterial Pressure with time in each patient.

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