

EFFECT OF PREVIOUS SCORPION BITE ON THE EFFICACY OF INTRATHECALLY ADMINISTERED LEVOBUPIVACAINE IN SUBARACHNOID BLOCK

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ABSTRACT

Objectives: Local anesthetics administered by spinal anesthesia acts through sodium channels. Mutations of sodium channels may be responsible for resistance to local anesthetic agents. The scorpion venom contains neurotoxins that block the sodium channels. In view of the high prevalence of scorpion stings in our region and observation of failure of spinal anesthesia in patients with a history of scorpion stings in routine practice, the present study is planned.

Methods: Forty patients of the American Society of Anesthesiologists Grade I or II who were undergoing infraumbilical surgery were divided into two groups as S (patients with h/o scorpion bite) and C (patients with no such history). The subarachnoid block was given with 3.2 ml of injection Levobupivacaine 0.5% heavy using 26 gauzes Quincke spinal needle. A blind observer recorded a sensory block using a needle prick and a motor block using the Bromage scale. Onset of sensory and motorized block, time to peak of sensory, and motor block and its relation to number of scorpion bites were observed in both the groups.

Results: The onset of sensory (2.61±1.68 mins) and motor blockade (2.91±1.80 mins) was significantly delayed in Group S (p=0.010 and 0.004, respectively). Time to peak of sensory and motor blockade was also prolonged in Group S (6.45±2.83 mins and 7.8±3.95 mins) compared to Group C (3.60±0.84 mins and 4.56±1.30 mins) which was statistically significant (p<0.05). Patients who had previous scorpion bites (Group S) had a significant failure rate of spinal anesthesia compared to the control group.

Conclusion: In this study, it was observed that the patients with scorpion bites had a significant failure rate of spinal anesthesia, suggesting probable resistance to the local anesthetic agents.

Keywords: Scorpion bite, Subarachnoid block, Spinal anesthesia, Bromage scale.

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INTRODUCTION

Regional anesthesia for the infraumbilical surgeries is not only performed for adequate anesthesia but also for excellent postoperative analgesia, reduced side effects, decreased blood loss, lower incidence of deep vein thrombosis, and shortened stay in post anesthesia care unit (PACU). Spinal anesthesia failure is an uncommon phenomenon. This may be erroneously attributed to poor technique/less skill on the part of the anesthesiologist. However, failure of subarachnoid block may occur even in expert hands. Causes of failure of spinal anesthesia may be poor patient positioning, incorrect insertion of spinal needle, spinal abnormalities, obesity, errors in drug injection, inaccurate dose of the drug, misplaced injection, inadequate intrathecal spread, inadequate drug action, local anesthetic resistance, etc [1-5]. The reported incidence of spinal anesthesia failure is 0.72–16%. In India, two types of poisonous species of scorpion are important – small red *Buthustamulus* and the large black *Palamneusgravimanus*. *Buthustamulus* is more toxic. *Mesobuthustamulus* (the Indian red scorpion) is the most lethal amongst all poisonous species of scorpions in India [6]. In our region, scorpion stings are common. The scorpion venom contains neurotoxins that block the sodium channels (beta-toxins). Delayed activation of sodium neuronal channels by the venom causes a massive release of endogenous catecholamines into the circulation resulting in clinical manifestations and complications of scorpion sting [7].

Local anesthetics administered by spinal anesthesia acts through sodium channels. Mutations of sodium channels may be responsible

for resistance to local anesthetic agents. Alpha and beta toxins of scorpion venom affect sodium channels. Scyllatoxin, charybdotoxin, and tityus toxin inhibits calcium-dependent potassium channels and also causes the opening of sodium channels at presynaptic nerve terminals. Sodium channels are composed of α and β subunits. A subunit has four homologous domains (D 1-4), each containing six transmembrane α helices (S1-S6). S4 segment plays a crucial role in channel activation. Scorpion β toxin binds to receptor site 4 of voltage-gated sodium channels, thereby modifying the activation process of the channel [8].

In view of the high prevalence of scorpion stings in our region and observation of failure of spinal anesthesia in patients with a history of scorpion stings in routine practice, the present study is planned.

Aims and objectives

The aims of this study were to evaluate the efficacy of spinal anesthesia in patients with the previous scorpion bites in terms of:

Primary objectives

1. Onset of sensory blockade
2. Onset of motor blockade.

Secondary objectives

1. Time to peak of sensory blockade
2. Time to peak of motor blockade.

METHODS

Study setting and design

This case-control study was pre-approved by the Institutional Ethics Committee (IEC) for the final permission (vide letter no. 126-144/Bio/Ethical/MC/09/19). After obtaining the permission of IEC, the study was conducted in a medical college hospital of central India. Well-informed written consent was obtained from the selected patients, with the previous history of one or more scorpion bites, posted for elective infraumbilical surgery under spinal anesthesia over 6 months.

Inclusion criteria

The following criteria were included in the study:

- Patients of the American Society of Anesthesiologists (ASA) Grades 1, 2, and 3.
- Patients between the age group of 18–70 years of either sex.
- Patients undergoing elective infraumbilical surgery under spinal anesthesia.
- Patients with a previous history of one or more scorpion bites.

Exclusion criteria

The following criteria were excluded from the study:

- ASA Grade 4 and above.
- Known history of allergy or sensitivity to injection Bupivacaine.
- Patients known intracranial space-occupying lesion raised intracranial pressure.
- Patients with pre-existing neurological diseases, peripheral neuropathies.
- Patients with infection at the injection site (risk of meningitis).
- Patients with known coagulation disorders.
- Pregnant or lactating females.

Patient's grouping

- Group S: Patients with a previous history of one or more scorpion stings.
- Group C: Patients with no history of scorpion sting comprised the control group.

Pre-anesthetic assessment of all the selected patients will be done with complete history, general physical and systemic examination, airway assessment, and spine examination, along with routine investigations, as for any standard infraumbilical surgery.

The patient was shifted to the operation theatre and routine monitors such as non-invasive blood pressure, electrocardiography, and pulse oximetry were attached. Baseline noninvasive blood pressure, heart rate, respiratory rate, and oxygen saturation on room air were recorded. An 18 Gauge intravenous line was tenable and ringer lactate infusion was started. After taking all aseptic measures, a subarachnoid block was given at L3–L4 intervertebral space with a 25 gauge spinal needle and hyperbaric levobupivacaine 0.5%, 3.2 ml will be administered after free flow of CSF. Immediately after injection, the patient was placed in the supine position. Electrocardiography, SpO₂, heart rate, and non-invasive blood pressure monitoring were done intraoperatively.

In the operating room, the following parameters were recorded:

- T0 – Time of subarachnoid block.
- T1 – Onset of the sensory blockade.
- T2 – Onset of motor blockade.
- T3 – Time of peak of sensory blockade.
- T4 – Time of peak of motor blockade.

The onset of sensory block was assessed using the ether-soaked gauze for every 2 min until complete loss of sensation at T8.

Motor blockade was assessed every 2 min using the modified Bromage Scale until score of 3 was achieved [9].

- Bilateral sustained straightening of leg;
- Unable to straighten leg;
- Just able to flex knees;

- Foot movement only;
- Complete paralysis.

The study parameters were defined as follows:

1. Onset of sensory block: Time interval from subarachnoid drug administration time to achieve T8 blockade.
2. Onset of motor block: Time interval from epidural drug administration time to Bromage scale 3.
3. Time of peak sensory and peak motor blockade: When the maximum/upper most level of the block was achieved and there was no further progression of the sensory or motor blockade above that level.

After 20 min of the waiting period, if the block was not found to be adequate, general anesthesia was administered. At the end of the surgery, all patients were shifted to PACU for postoperative monitoring during the first 24 h.

Statistical analysis

The statistical analysis of the data was carried out using the Statistical Package for the Social Sciences (SPSS Inc., Chicago, IL, version 17.0 for Windows). All quantitative variables were estimated using mean, and standard nonconformity; scores or skewed data were presented as median. Normality of data was checked by measures Kolmogorov–Smirnov tests of normality. For normally distributed data, means of quantitative variables of two groups were compared using student t-test. $p < 0.05$ was considered as statistically significant and $p > 0.05$ was considered as statistically insignificant.

RESULTS

Demographic data

The groups were comparable to each other in all respects (Table 1). Frequency and percentage of scorpion bites in the two groups were also comparable. Twenty-nine patients had a history of single bites, whereas eight patients were bitten twice, three patients thrice, and five patients were bitten 4 times (Table 2).

Onset of sensory/motor blockade

The onset and peak effect of sensory and motor block is significantly delayed statistically after exposure to a scorpion bite (Table 3).

It also depends on the number of exposures of scorpion bites (Table 4).

DISCUSSION

Panditrao *et al.* [10], in their study, demonstrated that scorpion bites may be responsible for the development of resistance to the act of local anesthetic agents. They observed a failed subarachnoid block in a patient posted for vaginal hysterectomy, so block was repeated one space above, but there was no effect again even after waiting period of 30 min. On enquiry, that the patient gave a history of scorpion bite twice, once at 17 years on her right foot and again about 8 months back. After that, balanced general anesthesia was given. On the 8th post-operative day, after explaining her possible resistance to local anesthetic agents, the patient was assumed left median, ulnar, and radial nerve blocks at the wrist and local penetration near the anatomical snuff box. There was neither sensory nor motor block. They concluded that the scorpion venom affects the pumping mechanism of sodium stations in the nerve fibres, which are involved in the mechanism of action of local anesthetic drugs. It may

Table 1: Characteristics of patients in the two groups

Parameters	Group S (n=20)	Group C (n=20)	p-value
Age in years (mean±SD)	50.06±5.81	48.46±6.43	0.414 (NS)
Gender (%)			
Male	12 (62.9%)	09 (48.6%)	0.368 (NS)
Female	08 (37.1%)	11 (51.4%)	0.368 (NS)

NS: Not significant ($p > 0.05$)

Table 2: Frequency and percentage of scorpion bites in the Group S

Number of scorpion bites	Number of patients (n)	Percentage (%)
1	13	65
2	03	15
3	01	05
4	03	15
Total	20	100

Table 3: The onset of sensory and motor blockade

Variables	Group S (mean±SD)	Group C (mean±SD)	p value	95% confidence interval
Onset of sensory blockade (min)	2.61±1.68	1.53±0.64	0.010 (S)	(-1.59)-(-0.034)
Onset of motor blockade (min)	2.91±1.80	1.60±0.63	0.004 (S)	(-2.17)-(-0.45)
Peak of sensory blockade (min)	6.45±2.83	3.60±0.84	0.0001 (S)	(-4.18)-(-1.51)
Peak of motor blockade (min)	7.80±3.95	4.56±1.30	0.001 (S)	(-5.12)-(-1.35)

Table 4: Relation of number of scorpion bites to onset of sensory and motor blockade, time to peak of sensory, and motor blockade

Number of scorpion bites	The onset of sensory blockade	The onset of motor blockade	The peak of sensory blockade	The peak of motor blockade
Group C 0	1.53±0.64	1.60±0.63	3.60±0.84	4.56±1.3
Group S 1	2.48±1.85	3.0±2.02	6.62±3.09	8.2±4.54
2	2.25±2.06	2.5±1.29	5.67±2.08	6.75±1.71
3	2.1±1.0	3.57±2.41	9.5±0.71	9.0±1.24
4	1.8±0.84	3.4±0.45	5.0±1.41	7.0±3.16
p-value	0.228	0.019	0.000	0.001

be accountable for the development of “resistance” to the action of local anesthetic agents [10,11].

A case-control study was done by Panditrao *et al.* [12] on the effect of the previous scorpion bites on the action of intrathecal Bupivacaine. Throughout the routine practice in the institution, it was observed that there were persistent events of inadequate/failed spinal anesthesia in patients with a history of single or manifold scorpion bite/s. The authors concluded that there seems to be a direct correlation between the times gone by of old, single or multiple scorpion bites and the development of resistance to the effect of local anesthetics administered intrathecally.

Similar studies were done by Trescot *et al.* [11] and Mehrotra *et al.* [13] on the effect of scorpion bite on subarachnoid blockade. There are some reasons for the failure of the block, either technical errors or errors due to chemical interactions. There are genetic reasons also like red hair individuals, and a history of single or multiple scorpion bites has recently been reported are resistant to subcutaneous local anesthetics.

The antigenic nature of scorpion venom makes it more significant as it may evoke a very intoxicating antigen-antibody response causing failure of the spinal blockade.

Panditrao *et al.* [14] studied a case of a repeated scorpion bite, which led to resistance to the effect of local anesthetics. An 80-year-old bronchial asthmatic male was posted for the left cataract extraction with intraocular lens implantation. He was administered peribulbar block/ left facial nerve block. Near was no sensory or motor block. After that, the peribulbar block was recurrent. Only partial akinesia was attained, so under intermittent intravenous sedation, the surgery continued for 40 min. In the post-operative period, no signs of any residual/delayed block were noted. On specific enquiry, the patient gave past of scorpion bite thrice, at the age of 27 years on his right foot, around 8–9 years back and again about 6–7 months back on his right hand. The cause of the disappointments may be due to technical inability to attain block. However, a failure that occurs despite the technically correct injection of the correct drug can be mystifying. As the scorpion venom is known to affect the driving mechanism of sodium channels in the couragefibres, which are involved in the device of action of local anesthetic drugs, it may be responsible for the development of “resistance” to the action of local anesthetic agents.

To test any possible correlation between scorpion bite and the changed response to spinal anesthesia, a case-control study was conducted by Issin *et al.* [15] involving patients with a history of scorpion bite/s and without such a history. The anesthetic management was identical inclusive of the subarachnoid block with 3.5 mL 0.5% bupivacaine heavy. The onsets of sensory, motor and peaks of sensory and motor blocks were observed with the pinprick method and Bromage scale. After waiting for 20 min, if the block was inadequate, then balanced general anesthesia was administered. We conclude that there appears to be a direct correlation amid the histories of old, single or multiple scorpion bites and the development of resistance to the effect of local anesthetics administered intrathecally.

Panditrao *et al.* [9] proposed a hypothesis, in which they reported a yet unrecognized development of resistance to the effect of local anesthetic agents managed through various routes due to single or multiple previous scorpion bites.

What this study add to existing knowledge

In this study, it was practical that the patients with scorpion bites had a significant failure rate of spinal anesthesia, suggesting probable resistance to the local anesthetic agents as observed in previous similar studies.

Limitations of the study

Effect of addition of adjuvants to spinal anesthesia in patients with history of previous scorpion bites was not studied in the present study.

CONCLUSION

In this study, it was experiential that the patients with scorpion bites had a significant failure rate of spinal anesthesia, suggesting probable resistance to the local anesthetic agents as observed in previous similar studies.

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