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Original Article

Anaesthesia Section

Prospective Study Evaluating the Association between Time since Scorpion Bite and Spinal Anaesthesia Outcomes

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ABSTRACT

Introduction: The drug mainly used in Spinal Anaesthesia (SA) is Local Anaesthetic (LA) agents. It acts via sodium channel by reversibly inhibiting the nerve transmission. Scorpion venom causes mutation in receptors of sodium channel that leads to LA resistance which results in failed SA. Although, there are few studies and many case reports, which shows direct association of scorpion bite with failed SA, but association of duration since, scorpion bite on outcome of SA is still not known.

Aim: To evaluate the association between time since scorpion bite and multiple bites and outcome of SA on patients posted for elective lower abdominal and lower limb orthopaedic surgeries.

Materials and Methods: This monocentric, prospective, single blind observational study was conducted in the Department of Anaesthesia at Rajarshi Dashrath Autonomous State Medical College (RDASMC), Ayodhya, Uttar Pradesh, India. The duration of the study was two years, from December 2019 to December 2021. A total of 33 patients of any gender and age between 18-70 years were taken and divided into three groups of 11 each. Groups were divided on the basis of history of duration since scorpion bite/sting. Group A included patients with history of scorpion bite being less than eight months, group B from 8-14 months and group C more than 14 months. SA was provided with 15 mg 0.5% hyperbaric bupivacaine. The pin prick method and Bromage scale were used to detect the onset of sensory (T1), onset of motor (T2), peak of sensory (T3) and peak of motor block (T4). General Anaesthesia (GA) was given if the SA was found inadequate or failed. The mean±Standard Deviation (SD), Student's t-test and Chi-square test were used for statistical analysis of data.

Results: The mean age of the study participants of group A was 49.27 years, group B was 50.27 years and group C was 52.18 years. Demographically, all the three groups were comparable. The authors have found that, block failed completely in group A. There was statistically significant increase of T1, T2, T3 and T4 in group B than group C ($p<0.05$). Statistically significant difference were not found between single scorpion bite and multiple scorpion bite in group B and group C in terms of SA characteristics T1, T2, T3 and T4 ($p>0.05$).

Conclusion: The present study concludes that, the duration of scorpion bite is a significant factor on the effect of SA in terms of sensory and motor block, but number of stings does not determine the sensory and motor characteristics of SA. The SA should not be given if, the history of scorpion bite is recent (less than eight months).

Keywords: Bupivacaine, General anaesthesia, Local anaesthetics, Motor block

INTRODUCTION

The SA is the most common mode of anaesthesia for various surgical procedures and procedure failure may occur with experts [1,2]. There are many causes of failed SA, including technical difficulty, poor positioning of the patient, incorrect insertion of spinal needle, spinal deformity (kyphosis, scoliosis, ligament calcification, disc-fusion), obesity, errors in preparation and injection of solutions, the inadequate spread of drugs through cerebrospinal fluid, ineffective drug action and LA resistance etc., [3]. Mechanism of action of LA, administered for SA, occurs through sodium channel. Therefore, one postulated action mechanism for LA resistance is receptor mutation associated with sodium channel abnormalities [4]. Because of the high prevalence of scorpion bite/sting in east Uttar Pradesh (UP), failed SA in patients with a history of scorpion bite is a frequent observation in routine practice. As scorpion venom causes mutation in the sodium channels that generate atypical receptor site, which result in LA resistance. Literature also confirms that, recent scorpion bites is one of the causes of failed SA [5-7]. Therefore, the present study was aimed to evaluate the association between the time since scorpion bite with the outcome of SA in patients with previous scorpion bites.

MATERIALS AND METHODS

This monocentric, prospective, single blind, observational study was conducted in the Department of Anaesthesia at Rajarshi Dashrath Autonomous State Medical College (RDASMC), Ayodhya, Uttar Pradesh, India. The duration of the study was two years, from December 2019 to December 2021. The approval from Institutional Ethical Committee (IEC) was obtained.

Inclusion criteria: After getting informed and written consent from the patients, all the patients of age 18-70 years, either gender, American Society of Anaesthesiologists (ASA) physical status I to II and history of scorpion bite/sting (multiple or single) were included in the study [8].

Exclusion criteria: Patients who refused SA, had allergy to LA, with co-morbities like diabetic neuropathy, on anticoagulant, with coagulopathy, recent spine injury, having spine deformity, local site infections were excluded from the study.

Sample size calculation: The study by Panditrao MM et al., reported a mean of 7.83±3.95 minutes vs 4.45±1.40 minutes for comparing peak of motor block between scorpion group and control bite group [5].

Following formula was used for calculation:

$N=(SD_1^2+SD_2^2)\ (Z\alpha+Z\beta)^2/(\mu_1-\mu_2)^2$

SD_1- Standard Deviation of group 1

SD_2- Standard Deviation of group 2

$Z\alpha$ at 95% confidence interval=1.96

$Z\beta$ at 80% power=0.84

μ_1=Mean of group 1

μ_2=Mean of group 2. Sample size was calculated by this formula was found 10 in each group with 95% Confidence Interval (CI) and 80% power. Finally, 33 patients were recruited into the study.

A total of 33 patients were included in the study, who were admitted for elective surgery under SA during study period. The patients were allocated into three groups, according to the time since scorpion bite.

Group A- A total of 11 patients with previous history of scorpion bite being less than 8 months.

Group B- A total of 11 patients with previous history of scorpion bite being between 8 months to 14 months.

Group C- A total of 11 patients with previous history of scorpion bite being more than 14 months.

Study Procedure

Before undergoing to various elective surgeries like hernioplasty, hysterectomy, fistulectomy, transurethral resection of prostate etc., under SA, every patient was examined and detailed history was taken during Preanaesthesia Checkup (PAC). In the preoperative area, a 20 gauge peripheral intravenous catheter was inserted and Ringer's lactate solution 10 mL/kg body weight of patient was started before the procedure. Meanwhile, standard monitors essential for monitoring the patient like electrocardiography, pulse oximeter, non invasive blood pressure, temperature probe were connected to patients. With the sitting position of patient on operation theatre table, sterile painting and drapping was done. After this intrathecal injection of 3 mL (15 mg) of 0.5% bupivacaine heavy over 15 seconds was given via spinal needle (25 Gz Quincke) in L2-L3 or L3-L4 intervertebral space. Anaesthesiologists performing the procedure were experienced and their experience varied between eight years to 20 years. Also, these anaesthesiologists were blinded to the group of patients allotted. After placing the patients in supine position, the authors have observed and documented the parameters T0: time of spinal injection, T1: onset of sensory block, T2: onset of motor block, T3: peak of sensory block, T4: peak of motor block.

Sensory block was assessed by pin prick with 24 Gz hypodermic needle every 30 seconds and onset of sensory block was defined as the time when patient could not feel the pain. Motor block was assessed with the Bromage scale every 30 seconds [9]. The authors have defined onset of motor block, when patient was not able to move hip joint. Time to achieve peak sensory block and motor block were defined as the time when sensory and motor block was fixed or couldn't progress further. The block was considered to be adequate when level of sensory/motor block of up to T6-T8 was achieved. If after 20 minutes period, the block was found to be inadequate or failed, GA was administered. At the end of surgery, all patients were transferred to Intensive Care Unit (ICU) for postoperative monitoring during first 24 hours. The anaesthetist, who assessd the sensory and motor block for all patients was blinded to the group of patients. The assessment was done as per the established checklist [10].

STATISTICAL ANALYSIS

The SPSS version 16.0 was used for analysing statistical parametric and continuous data. The parametric data were expressed as mean±SD. Student's t-test was used to analyse parametric data between the two groups and ANOVA for three groups. The Chi-square test was used for the analysis of continuous and categorical variables. A p-value of <0.05 was considered statistically significant, and a p>0.05 was not considered statistically significant.

RESULTS

The mean age of the study participants of group A was 49.27 years, group B was 50.27 years and group C was 52.18 years. The distribution of study population according to age, gender, ASA physical status in group A, group B and group C shown in [Table/Fig-1]. There was complete failure of SA in terms of T1, T2, T3, and T4 in group A. All spinal characteristics in terms of T1, T2, T3 and T4 were delayed in group B on comparision with group C (p<0.05) shown in [Table/Fig-2]. In [Table/Fig-3], no significant difference between single scorpion bite and multiple scorpion bite in group B in terms of spinal block characteristics T1, T2, T3 and T4 (p>0.05). In [Table/Fig-4], there was no significant difference was found between single scorpion bite and multiple scorpion bite in group C in terms of spinal block characteristics T1, T2, T3 and T4 (p>0.05).

Groups	Age (in years) Mean±SD	Gender M:F	H/O scorpion bite duration (in months) Mean±SD	Single: multiple scorpion bite	ASA I:II
A	49.27	6:5	5.55±2.02	9:2	8:3
B	50.27	7:4	11.73±2.00	8:3	7:4
C	52.18	4:7	22.82±11.35	6:5	7:4
p-value	0.751	0.428*	<0.001	0.170	0.873

[Table/Fig-1]: Distribution of patients according to age, gender, history of scorpion bite duration, single or multiple scorpion bite, ASA.
*Chi-square test

Parameters (in seconds)	Group A (n=11)	Group B (n=11)	Group C (n=11)	F-value	[1]p-value
	Mean±SD	Mean±SD	Mean±SD		
T1 (onset of sensory block)	-	162.50±58.98	123.64±9.24	4.71	0.044*
T2 (onset of motor block)	-	205.00±65.90	151.82±17.22	6.68	0.019*
T3 (peak of sensory block)	-	248.75±49.70	212.73±12.72	5.40	0.033*
T4 (peak of motor block)	-	320.00±59.28	275.45±28.76	4.75	0.044*

[Table/Fig-2]: Onset of sensory block and motor block, time to peak sensory and motor block in groups.
*=Significant (p<0.05, [1]=Unpaired t-test

Group B (in seconds)	Single bite (n=8)	Multiple bites (n=3)	t-value	p-value
	Mean±SD	Mean±SD		
T1 (onset of sensory block)	172.86±55.29	90.00±0	1.40	0.211
T2 (onset of motor block)	217.14±60.75	120.00±0	1.50	0.185
T3 (peak of sensory block)	257.14±47.16	190.00±0	1.33	0.231
T4 (peak of motor block)	330.00±56.27	250.00±0	1.33	0.232

[Table/Fig-3]: Onset of sensory block, motor block, time to peak sensory and motor block between single and multiple bites in group B.

Group C (in seconds)	Single bite (n=6)	Multiple bites (n=5)	t-value	p-value
	Mean±SD	Mean±SD		
T1 (onset of sensory block)	125.00±10.49	122.00±8.37	0.52	0.618
T2 (onset of motor block)	156.67±18.62	146.00±15.17	1.03	0.332
T3 (peak of sensory block)	216.67±13.66	208.00±10.95	1.14	0.283
T4 (peak of motor block)	280.00±32.86	270.00±25.50	0.55	0.593

[Table/Fig-4]: Onset of sensory block and motor block, time to peak sensory and motor block between single and multiple bites in group C.

DISCUSSION

Failure of SA is not an uncommon phenomenon. There are multiple factors which lead to this failure [3]. The authors observed failure in spinal block with bupivacaine due to mutation in receptors of Na+ channel [11]. In sodium channel, amino acid sequences like of phenylalanine and tyrosine may show genetic variation that causes atypical receptor site. The α and β are subunits of sodium channel. The alpha subunit involves four homologous domains and each domains consists of six trans-membrane segments (S1-S6). Interaction of 6th segment of 4th domain (IV-S6) of α subunit with LA is responsible for action of LA that leads to resistance of drug [10,11].

In the present study, proficient, experienced (8 years to 20 years) and expert anaesthetists had performed the procedure. So the factors like poor positioning of patient, drug error or technical failure which could lead to the complete block failure, or delayed effect were ruled out. The authors also excluded those patients, who had diseases like diabetic neuropathy, or having spine deformity. An extensive literature search revealed that, in few patients with history of scorpion bite, resistance to LA is associated with either drug is given via spinal/ intrathecal or epidural or peripheral nerve block like brachial plexus block or peribulbar block [7,12,13]. A significant number of SA failure or delayed effect was documented in patients with history of scorpion bite [5-7,12,13]. Scorpion sting/bite in past was the most likely explanation for this failed or delayed effect of SA. Patients having history of scorpion bite may show resistance to SA causing incomplete block, delayed effect or complete block failure [7].

In the present study, the groups were divided on the basis of history of scorpion bite or sting. Demographic distribution of patients in the above mentioned group was found comparable. The result of the present study, in that patients with recent scorpion bite or less than eight months (group A) showed complete failure of spinal block SA. Panditro MM et al., conducted the study on bupivacaine SA on the patients having history of scorpion bite and conclude that, patients with scorpion bite history less than eight months showed complete failure of the spinal block which requires conversion to GA [5]. Kosam D et al., also showed the same results and comparable to current study. They also reported that, recent scorpion bite history less than six months were associated with complete spinal block failure and necessitate conversion to GA [6]. Patient given history of scorpion bite more than eight months but that is less than 14 months, (group B), showed delayed onset of sensory or motor block in the study. Kosam D et al., finding were similar to present study and they conclude that, the patients giving history of scorpion bites more than six months, showed delayed onset of sensory and motor block and also delayed peak of sensory and motor block or both [6].

Patients giving scorpion bite history more than 14 months (group C) showed adequate effect of SA. Kosam D et al., showed that, few patients of scorpion bite >one year back had adequate subarachnoid block [6]. But Panditrao MM et al., showed that, the patients with scorpion bites older than a year showed delayed onset and delayed peak of the sensory block or the motor block or both [5]. In the above two studies, the authors can observe that, in a study by Kosam D et al., 14 months has been taken as limit after which SA results were adequate, in comparison to 12 months in study by Panditrao MM et al., that is why, different result has been seen in above two studies. The present study was aimed to conclude more about the results and have taken 14 months as limit. On comparing the groups to find the impact of single or multiple stings, there was no significant effect on SA characteristics. However, Panditrao MM et al., noted that, either single or multiple but most recent scorpion bites were associated with complete failure of the spinal block [5]. So, the duration of bite is more important than number of bites. In another case report, they stated that, single repeated scorpion bite may cause development of resistance to the LA drugs used to achieve blocks by various routes [12].

Limitation(s)

It was a monocentric study, for more reliable results, multicentric study may be planned. Till now the study was done to show the association between scorpion bite and LA, which was given via intrathecal route, so further studies may be planned to evaluate the association between scorpion bite and LA, used via other routes of regional anaesthesia like epidural or nerve blocks or plain block.

CONCLUSION(S)

The authors conclude that, duration since scorpion bite is a significant factor for the effect of SA on sensory and motor block, but number of stings does not determine the sensory and motor characterics of SA. There must be a column in PAC form about scorpion bite/sting history and duration since scorpion bite where scorpions are predominantly present in region like east UP and anaesthesiologist must question about that and document in the form. Regional anaesthesia should not be given if, a recent history of scorpion bite (less than eight months) is present.

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