Comparison of different regimens of intravenous dexmedetomidine on duration of subarachnoid block

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Abstract

Background and Aims: Many studies have studied the effect of intravenous dexmedetomidine on the prolongation of the duration of the subarachnoid block (SAB). These studies had administered dexmedetomidine using different regimens. This study was designed to find out the suitable regimen with maximum advantages and minimum disadvantages.

Material and Methods: Ninety-three ASA 1 and 2 patients scheduled to undergo surgeries under SAB were randomly allocated into three groups namely B, M, and BM. After SAB, Group B received 0.5 μg/kg of dexmedetomidine bolus over 15 min, Group M received 0.5 μg/kg/h of dexmedetomidine infusion until the end of surgery, Group BM received both bolus and infusion.

Results: The time to achieve T10 sensory level (SL) was significantly faster in the Groups B and BM than in the Group M. Maximum block height achieved was T4 and was same in all the groups. The Time to achieve maximum SL and Bromage 3 was comparable in all groups. The two-segment regression time and time to reach Bromage 0 was significantly higher in Groups M and BM than Group B. The time for a first request of analgesia was similar in Groups M and BM. The maximum sedation attained in all groups was Ramsay Sedation Score of 3. Side effects such as bradycardia, hypotension, and desaturation were comparable between the groups.

Conclusion: We conclude that the continuous infusion of dexmedetomidine results in more advantages than just a bolus dose. Therefore, we suggest using only the maintenance dose of intravenous dexmedetomidine after subarachnoid blockade for prolonging the duration and achieving sedation.

Key words: Different regimens of administration, intravenous dexmedetomidine, subarachnoid block

Introduction

Subarachnoid block (SAB) is one of the most frequently used regional anesthetic techniques. SAB is distinguished by its ease of performance with a definite end point, rapid onset of action, excellent anesthetic efficacy, and motor blockade. SAB is suited for interventions that are done below the umbilicus. However, postoperative pain is a major problem after SAB.

A variety of adjuvants are used to improve the analgesic effect of local anesthetics after SAB.[1]

The addition of adjuvants to local anesthetics gained important due to the belief that it will decrease the dosage of local anesthetic and thus the occurrence of adverse effects. Despite the abundance of various adjuvants, there is a continuing dispute whether this practice adds to the clinical advantage or just complicates the procedures and introduces risks for medication error.[2]
Dexmedetomidine is a highly selective α2-adrenoceptor agonist. It provides sedation, analgesia, sympatholysis, and anxiolysis. It is used as a preemptive medication to attenuate the sympathetic responses to surgery. Dexmedetomidine potentiates anesthetic effects of other intraoperative anesthetics. Intravenous administration of dexmedetomidine was found to prolong the duration of SAB.

Many studies demonstrate that intravenous administration of dexmedetomidine prolongs the duration of SAB. Even though, dexmedetomidine is recommended to be infused as a bolus followed by maintenance for its optimum effect, it is administered using different regimens. Some previous studies were done with the administration of the bolus dose alone and some were done with the maintenance dose alone. However, the majority of previous studies were done with the administration of both bolus and maintenance dose. The current study was designed to know which regimen of administration of intravenous dexmedetomidine in a patient who is under SAB, gives maximum advantages and minimum disadvantages.

Material and Methods

This prospective study was undertaken in the Department of Anaesthesiology and Critical Care, JIPMER, Puducherry. After acquiring approval from the institutional ethics committee and written informed consent from the patients, 93 patients scheduled for surgeries under SAB meeting the inclusion criteria (patients with ASA 1 and 2 aged between 18 and 60 years posted for lower abdominal, gynecological, and orthopedic surgeries) were enrolled for the study. The study was registered with Clinical Trial Registry of India (ctri.nic.in - No — CTRI/2014/05/004616). Patients with allergy to dexmedetomidine, heart block, arrhythmias, patients on calcium channel blockers, adrenergic receptor blockers, ACE inhibitors, α-adrenergic agonists, pregnant patients were excluded from the study.

Based on the previous study findings of Elcicek et al., sample size of minimum 31 in each group was calculated using OpenEpi Version 2.3.1 software, with the power of 80% and confidence interval of 95%.

Ninety-three patients were randomly divided into three groups — Bolus group (B), maintenance group (M), and bolus and maintenance group (BM) with 31 patients in each group with the help of a random list generated by computer and opaque sealed envelope method. Patients were preloaded with 10 ml/kg of ringer lactate. SAB with 2.8 ml of 0.5% hyperbaric bupivacaine was given for all the patients. Once the patient turned to supine after SAB, Group B patients were infused with 0.5 μg/kg of dexmedetomidine over 15 min, whereas the Group M patients were infused with 0.5 μg/kg/h of dexmedetomidine until the end of surgery. Group BM patients were given 0.5 μg/kg of dexmedetomidine over 15 min followed by 0.5 mcg/kg/h until the end of surgery. Heart rate (HR), mean blood pressure (MBP), and pulse oximetry were monitored and recorded every 5 min until the end of surgery.

Sensory block level was evaluated by pinprick sensation using a blunted 25-gauge needle along the mid-clavicular line every 2 min until T10 level and then every 5 min until the highest level was attained. Sensory block level was evaluated every 5 min after the end of surgery until regression of two-segment from the highest level. Highest level means there will be no change in three consecutive readings. All the durations were calculated by taking the time of spinal injection at time 0. Time taken to reach maximum sensory level (SL), time for the first request for analgesia by the patient (T analgesia) and time for two-segment regression of SL from maximum block height reached were also noted.

The motor blockade was assessed according to modified Bromage scale. Time to reach Bromage 3 was evaluated every 2 min, from the time of intrathecal injection. Time for regression of motor block to modified Bromage 0 was also noted.

Sedation was measured using Ramsay Sedation Score (RSS) at the time of incision and then every 5 min till 15 min and every 15 min till the end of the operation. Oxygen was given via facemask when the oxygen saturation decreased below 95%. Hypotension (reduction in systolic blood pressure by more than 20% from baseline or <90 mm Hg) was treated with intravenous doses of mephentermine. Bradycardia defined as pulse rate <50 beats/min was treated with intravenous atropine 0.6 mg.

Statistical methods

The data analysis was performed using statistical software SPSS for Windows, Version 16.0, SPSS Inc, Chicago. Analysis of variance (ANOVA) test has been used to judge the mean significance of the study parameters of the three groups of patients. The Chi-square test was used to verify the significance of the difference in categorical study parameters between the three groups.

Results

Demographic characters such as age, height, weight, and gender distribution were statistically comparable. Spinal anesthesia characteristics such as time to reach T10, time
for maximum SL, time for two-segment regression, time for first request for analgesia, time to reach Bromage 3, and Bromage 0 are shown in Table 1. Patients in the Group BM (2.42 ± 0.92 min) attained T10 segment early (P < 0.05) when compared to Group B (2.61 ± 1.26 min) and Group M (3.48 ± 1.26 min). Maximum SL achieved was T4 and the minimum level achieved was T6. There was no statistical significance in the maximum SL attained by the two groups (P - 0.057). Even though patients in the Group BM (7.68 ± 1.64 min) achieved maximum SL faster than other groups (Group B in 7.74 ± 2.76 min and Group M in 8.74 ± 2.32 min), there was no statistical significance in time to reach maximum SL in between the three groups (P - 0.127). There was no statistical significance in the time to attain complete motor block (Bromage 3 score) (P - 0.179).

Regression of SL by two-segment from maximum SL was faster in the Group B (84.8 ± 9.32 min) when compared to other groups (Group M in 94.6 ± 20.1 min and Group BM in 101.48 ± 10.7 min). There was no statistical significance in two-segment regression in between Groups M and BM (P - 0.062), but the same was significant in between Groups M and B (P - 0.008) and between Groups B and BM (P - 0.001). Patients in Group B requested for analgesia early (170.8 ± 14.4 min) when compared to Group BM (204.6 ± 16.51 min) and Group M (203 ± 12.3 min). There was statistical significance between Groups M and B (P - 0.001) and Groups B and BM (P - 0.001). There was no statistical significance between Groups BM and M (P - 0.669). Recovery of motor block (attaining Bromage 0) by patients was same like a first request for analgesia. All the patients in all the groups reached RSS 3 by 7 min and throughout the procedure, the same sedation score was maintained without any change in all groups (P - 0.479). Hemodynamic parameters (HR and MBP) were stable throughout the procedure. Hypotension, bradycardia, and desaturation occurred in few patients, but there was no statistical significance [Table 2].

### Discussion

In our study, B and BM groups attained T10 segment faster than Group M. The faster onset of T10 segment blockade for Groups B and BM could be due to the early attainment of peak level of action of dexmedetomidine on bolus administration for both groups when compared to Group M. Even though, it was statistically significant, the time difference between three groups was observed to be <1 min, which is clinically insignificant. Reddy et al. [7] study showed a faster onset of sensory blockade with a time of 2.91 ± 1.16 min whereas Gupta et al. [9] study attained T10 sensory blockade at 3.1 ± 1 min. This difference from our study might be due to the difference in the dosage pattern in other studies when compared to our study.

In our study, the three groups displayed no significant difference in the maximum block height. This property is in accordance with previous studies [7,10]. On contrast, Harsoor et al. [11] study showed a median maximum SL of T10 (T8-T12) in dexmedetomidine group, the lesser dose of bupivacaine used might account for the lower blockade level in the study. In the current study, three groups displayed no significant difference in the time for reaching maximum sensory block. Dinesh et al. [6] found that there is a statistical difference in the time attained for the maximum sensory block between dexmedetomidine group and control group. The usage of a higher dosage of bupivacaine and dexmedetomidine in the above study might probably explain the statistical difference for the time to attain a higher sensory block.

The time for two-segment regression was significantly longer in Groups M and BM compared with Group B in our study. This might be because there was a continuous infusion of dexmedetomidine in M and BM groups, but not in Group B. The amount of dexmedetomidine given was also statistically significant among the groups. The current study showed

### Table 1: Comparison of time to T10, time for maximum SL, two segment regression, Bromage 3, Bromage 0, Sedation 3, time for Ramsay Sedation Score 3

| Parameters                                      | Group B          | Group M          | Group BM         | P value | Pair wise significance |
|-------------------------------------------------|------------------|------------------|------------------|---------|------------------------|
| Time to T10 (min)                               | 2.6±1.3          | 3.5±1.3          | 2.4±0.9          | 0.001   | 0.004                  |
| Time to maximum SL (min)                        | 7.7±2.8          | 8.7±2.3          | 7.7±1.6          | 0.127   | 0.008                  |
| Two segment regression (min)                    | 84.8±9.3         | 94.6±20.1        | 101.5±10.7       | 0.001   | 0.062                  |
| Bromage 3 (complete motor block in min)         | 4.3±1            | 4.4±1.2          | 4.8±1.1          | 0.179   | 0.001                  |
| Bromage 0 (Motor Recovery in min)               | 185.5±13         | 207.5±23         | 208.1±21         | 0.002   | 0.902                  |
| T Analgesia (min)                               | 170.8±14.4       | 203±12.3         | 204.6±16.5       | 0.001   | 0.669                  |
| Time to reach Ramsay sedation score 3           | 6.8±2.8          | 6.2±1.6          | 6.3±1.7          | 0.479   | 0.001                  |

Time taken to reach T10, Time for Maximum SL, Two segment regression, Bromage 3, Bromage 0, Time for first request for analgesia (T analgesia) are presented as mean ± S.D. Statistical analysis was done by F-test. N = Number of patients, S.D = Standard deviation; SL = Sensory level

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Conflicts of interest
There are no conflicts of interest.

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Table 2: Comparison of side effects

| Side effects    | Group B n (%) | Group M n (%) | Group BM n (%) | P       |
|-----------------|---------------|---------------|----------------|---------|
| Hypotension     | 14 (45)       | 6 (13)        | 13 (41)        | 0.069   |
| Bradycardia     | 3 (9)         | 0 (0)         | 2 (6)          | 0.228   |
| Desaturation    | 2 (6)         | 6 (13)        | 4 (12)         | 0.317   |

Test done was Chi-square test, n = Number of patients