Comparison of Intravenous Bolus and Infusion of Dexmedetomidine on Characteristics of Subarachnoid Block

Tripti Vatsalya, Chandrakant Waikar, Madhurima Singh
Department of Anaesthesiology, Gandhi Medical College, Bhopal, Madhya Pradesh, India

Abstract

Aims: Dexmedetomidine is very dynamic drug, used for analgesia, sedation, blunting the laryngoscopic responses and as adjuvants in regional anesthesia. Studies have shown that intravenous (iv) dexmedetomidine given during spinal anesthesia increases the quality of subarachnoid block (SAB). In this study, we compare the two iv regimen of dexmedetomidine on analgesic effect of spinal anesthesia. One is bolus dose of dexmedetomidine and other is infusion during the surgery, both given after induction of spinal anesthesia. Subjects and Methods: Sixty American Society of Anesthesiologists I and II patients scheduled to undergo surgeries under SAB were randomly allocated into two groups namely B and I. After SAB with 3.0 ml of bupivacaine 0.5% heavy, Group B received 0.5 µg/kg of dexmedetomidine bolus over 15 min, Group I received 0.5 µg/kg/h of dexmedetomidine infusion until the end of surgery. Statistical Analysis Used: All parametric data were statistically analyzed using Student’s t-test and nonparametric data analyzed using Chi-square test and Fischer exact test as appropriate. P < 0.05 was considered as statistically significant. Statistical analysis was performed using the SPSS. Results: Time to reach desired level T10 was quick in Group B compared to Group I. Regression of sensory and motor was prolonged in Group I compared to Group B. Total duration of analgesia was significantly prolonged in Group I 230.39 ± 16.20 compared to Group B 196.01 ± 14.32 and the difference is statistically significant (P = 0.0001). Both groups had Ramsay sedation score of 3 which lasted for 45 min in Group B while it was maintained in Group I. Side effects profile of both groups was comparable with few incidence of bradycardia and hypotension in both groups requiring treatment. Conclusions: We conclude that the continuous infusion of dexmedetomidine after SAB results in prolonged analgesia than just a bolus dose. Therefore, we suggest use of the maintenance dose of iv dexmedetomidine after SAB for prolonging the duration and achieving adequate sedation.

Keywords: Intravenous dexmedetomidine, postoperative analgesia, subarachnoid block

Introduction

Subarachnoid block (SAB) is one of the most frequently used regional anesthetic techniques. Spinal anesthesia produces intense sensory and motor blockade with added benefits like reducing the metabolic stress response to surgery, reduction in blood loss, decrease in the incidence of venous thromboembolism, reduction in pulmonary compromise (particularly in patients with the advanced pulmonary disease), and the ability to monitor the patient’s mental status. The important limitation is the postoperative analgesia and needs for intraoperative sedation obtained by intravenous (iv) and intramuscular (IM) administration of drugs. Other important way is to add adjuvants to drugs used for SAB. One new approach gaining importance is to use iv dexmedetomidine to increase the quality of SAB, and along with this it also provides sedation during the perioperative period. Thereby desirable goals, postoperative analgesia and intraoperative sedation are achieved.

Dexmedetomidine is a highly selective α2 adrenoceptor agonist with sedative and analgesic properties. It is chemically related to clonidine but has a much greater affinity for α2-receptors over α1 receptors (1620:1 compared to 200:1 for clonidine). This drug is approved for use in short-term sedation in critical care. However, the properties of dexmedetomidine are well suited for perioperative period. Due to its sedoanalgesic properties, it is used widely in general anesthesia. It is also used as an adjuvant in SAB,[1,2] epidural block,[3,4] and brachial...
plexus block\textsuperscript{[5,6]} along with local anesthetics to increase duration. Dexmedetomidine is used intravenously as bolus\textsuperscript{[7-9]} and also as bolus plus infusion\textsuperscript{[10-12]} after SAB in various studies, with very effective results. The primary aim of this study was to assess the quality of SAB on different iv regime of dexmedetomidine.

**Subjects and Methods**

This prospective study was undertaken in the Department of Anaesthesiology, Gandhi Medical College Bhopal after acquiring approval from the Institutional Ethics Committee and written informed consent from the patients. This randomized, double-blind, prospective study was conducted on sixty patients of American Society of Anesthesiologists Grades I and II, aged between 18 and 60 years undergoing lower abdominal and lower limb surgeries under SAB.

Patients with allergy to dexmedetomidine, cardiac diseases like heart block, arrhythmias, patients on drugs such as calcium channel blockers, adrenergic receptor blockers, angiotensin converting enzyme inhibitors, \(\alpha\)-adrenergic agonists, and pregnant patients were excluded from the study.

All patients were kept nil per oral for 6 h. In the operation theater, all patients were connected to electrocardiography, peripheral oxygen saturation (SpO\(_2\)), and non-invasive blood pressure monitor and all the basal parameters such as NIBP, heart rate, SPO\(_2\) were recorded. An iv line was obtained with 18 gauge cannula, and all patients were preloaded with Ringer lactate solution 10 ml/kg body weight.

After sterile painting and draping in sitting position, all the patients received 3 ml of hyperbaric bupivacaine for SAB in L\(_{5}\)-L\(_{4}\) interspinous space through 25G Quincke spinal needle. All patients were turned supine, and patients of Group B received iv 0.5 \(\mu\)g/kg dexmedetomidine over 10 min as bolus. Moreover, Group I received 0.5 mg/kg/h until the end of surgery.

The level of sensory and motor blockade was checked every 2 min until the maximum level of the block was achieved and after that every 5 min interval subsequently. Intraoperatively, heart rate, blood pressures, and SpO\(_2\) were recorded every 5 min until the end of surgery and every 15 min in the 1\(^{st}\) postoperative h followed by every half hourly for the next 3 h. Sedation level was assessed by Ramsay score every 15 min, intraoperatively.

**Ramsay sedation score**

1. Anxious or agitated
2. Co-operative and tranquil
3. Drowsy but responsive to command
4. Asleep but responsive to glabellar tap
5. Asleep with a sluggish response to tactile stimulation
6. Asleep and no response.

Patients were monitored intraoperatively for hypotension, and bradycardia hypotension was defined as \(>20\%\) decrease in mean arterial pressure (MAP) and was treated with fluid boluses and injection ephedrine 6 mg iv. Bradycardia was defined as heart rate \(<50\) beats/min and treated with injection atropine 0.6 mg iv.

Parameters observed were time for the onset of sensory and motor blockade \(T_{10}\), maximum cephalad level of sensory block achieved, time for two segment regression, total duration of analgesia, and motor blockade.

Onset of sensory block was considered when the loss of pinprick sensation was noted at \(T_{10}\) and onset of motor block when complete loss of motor power was achieved (Bromage Scale 3). Postoperatively, pain was assessed using visual analogue scale (VAS). The total duration of analgesia was defined as time from administration of SAB until the first complaint of pain (VAS \(>4\)) and for rescue analgesia 100 mg IM tramadol was used. Complications such as hypotension, bradycardia, nausea, vomiting, shivering, urinary retention, and headache were noted. An anesthesiologist, who was blinded to the study drug used, documented all the parameters. All parametric data were statistically analyzed using Student’s \(t\)-test and non-parametric data analyzed using Chi-square test and Fischer exact test as appropriate. \(P < 0.05\) was considered as statistically significant. The statistical analysis was done using Statistical Package for Social Sciences Version 14.0 statistical Analysis Software.

**Results**

The demographic data are presented in Table 1. Age, height, weight, and duration of surgery were comparable.

Table 2 shows time to reach \(T_{10}\) which is 2.5 ± 1.06 for Group B and 3.4 ± 1.87 for Group I. The difference is statistically significant \((P < 0.05)\). Time to maximum sensory level (min) in

| Parameters | Group B | Group I | \(P\) |
|------------|---------|---------|------|
| Age        | 43.01±9.04 | 42.09±8.12 | 0.6790 |
| Height (cm) | 163.32±6.21 | 161.14±8.0 | 0.2432 |
| Weight (kg) | 66.82±9.21 | 67.01±12.0 | 0.9454 |
| Duration of surgery | 82.23±2.36 | 85.85±12.36 | 0.1205 |

**Table 2: Sensory and motor characteristics of both groups**

| Parameters | Group B | Group I | \(P\) |
|------------|---------|---------|------|
| Time to T10 (min) | 2.5±1.06 | 3.4±1.87 | 0.025 |
| Time to maximum SL (min) | 7.23±3.08 | 8.36±3.32 | 0.177 |
| Two segment regression (min) | 89.23±12.01 | 99.38±11.41 | 0.001 |
| Bromage 3 (complete motor block in min) | 4.63±2.36 | 4.98±6.25 | 0.7752 |
| Bromage 0 (motor recovery in min) | 182.07±15.28 | 209.89±11.21 | 0.0001 |
| T analgesia (min) | 196.01±14.32 | 230.39±16.20 | 0.0001 |
| Time to reach Ramsay sedation score 3 | 6.5±2.5 | 6.8±2.9 | 0.669 |

SL=Sensory level
Group B is 7.23 ± 1.08 and for Group I 8.36 ± 2.32, \( P = 0.0187 \) which is statistically insignificant.

Two-segment regression (min) for Group B is 89.23 ± 12.01 and for Group I is 99.38 ± 11.41, \( P = 0.001 \) which is highly significant [Table 2].

Time for onset of motor blockade for Group B is 4.63 ± 2.36, and for Group I is 4.98 ± 6.25 with \( P = 0.7752 \) which is not statistically significant [Table 2]. Time for motor recovery was prolonged in Group I (209.89 ± 11.21) as compared to Group B (182.07 ± 15.28) [Table 2].

The total duration of analgesia was significantly prolonged in Group I (230.39 ± 16.20) as compared to Group B (196.01 ± 14.32) [Table 2]. MAP [Graph 1] was lower from the baseline in both groups at all times of observations, however, the fall was not <20%. Similarly, heart rate [Graph 2] also remained at lower values than the baseline, but the fall was not statistically significant. The difference in both MAP and heart rate were not statistically significant in both groups [Graph 3] showing Ramsay sedation score (RSS). In this graph, both groups achieved score 3, but it lasted for around 45 min in group B while it was maintained in group I.

**DISCUSSION**

Both groups are comparable to demographic profiles [Table 1].

As shown in Table 2, time to reach \( T_{10} \) is statistically significant among both groups. It is faster for Group B than Group I. This may be due to the fact that bolus dose administration has more effect fastening the time to reach the \( T_{10} \). Similar results are found by Thomas *et al.* [13] Thomas *et al.* compare the three groups of dexmedetomidine. In their study, after SAB, Group B received 0.5 \( \mu \)g/kg of dexmedetomidine bolus over 15 min, Group M received 0.5 \( \mu \)g/kg/h of dexmedetomidine infusion until the end of surgery, Group BM received both bolus and infusion. They also found quick time to attain \( T_{10} \) in Group B and BM receiving bolus doses of dexmedetomidine.

Time to reach maximum sensory level is not statistically significant between the groups similar to that observed by Thomas *et al.* [13] But Dinesh *et al.* [10] found that group receiving bolus reaches maximum sensory level faster than control group. This may be explained by a higher loading dose of dexmedetomidine bolus of 1 \( \mu \)g/kg used in their study.

Two-segment regression was earlier in Group B than Group I. The difference is statistically significant. This may be due to long duration of action in Group I, as drug was used as an infusion. Similar results are also found by Thomas *et al.* [13] Similarly, Dinesh *et al.* [10] also found delayed two-segment regression in group receiving dexmedetomidine (bolus and maintenance both) as compared to control group.

Time for a complete motor block for both groups was not statistically different from each other. Similar results are found in previous studies [10,13]. This may be explained as the difference of time to reach maximum sensory level between both groups is very less (<1 min). Harsoor *et al.* [11] found similar results when comparing dexmedetomidine as bolus 0.5 \( \mu \)g/kg followed by 0.5 \( \mu \)g/kg/h intravenously with control group.

---

**Table 3: Side effects**

| Side effects  | Group B (n = 30) | Group I (n = 30) | \( P \) |
|--------------|-----------------|-----------------|------|
| Hypotension  | 3               | 1               | 0.306|
| Bradycardia | 2               | 1               | 0.500|
| Shivering    | -               | -               |      |
| Nausea       | 2               | 1               | 0.500|
| Vomiting     | -               | -               |      |

---

**Graph 1:** Mean arterial pressure

**Graph 2:** Heart rate

**Graph 3:** Ramsay sedation score
In both groups, the time to reach RSS is similar and with no significant statistical difference. All patients achieved the RSS score of 3 during the operation. However, it is maintained by Group I and it last for 45 min for Group B [Graph 3]. Harsoor et al.[11] used dexmedetomidine in dose of 0.5 μg/kg bolus over 10 min before SAB, followed by an infusion of 0.5 μg/kg/h also stated adequate sedation in their study. However, in a study done by Al-Mustafa et al.[12] they found RSS score 5 in 3 patients, 4 in 19 patients, and 3 in 1 patient. This score of more than 3 in the majority of patients can be explained by higher loading dose (1 μg/kg) of dexmedetomidine used in their study. Similarly, study done by Dinesh et al.[10] also shows higher RSS more than 3, as they also used a higher loading dose of dexmedetomidine similar to Al-Mustafa et al.[12] No patient was found to desaturate due to sedation. So dexmedetomidine can provide adequate sedation during SAB.

Time for complete motor recovery is significantly more in Group B. This also can be explained by the long effect of infusion then the bolus dose.[13] The time taken for regression of motor blockade to modified Bromage scale 0 was significantly prolonged in group receiving dexmedetomidine (220.7 ± 16.5 min) in a study done by Dinesh et al.[10] Which is more than our study as they combine the bolus followed by infusion of dexmedetomidine.

Total duration of analgesia for Group I was significantly more in than Group B. This prolonged sensory analgesia can be attributed to infusion of the dexmedetomidine prolonging the effect. This is also found in their study by Harsoor et al.[11] Al-Mustafa et al.,[12] Thomas et al.,[13] Dinesh et al.[10] Total duration of sensory block in the study done by Dinesh et al.[10] is 269.8 ± 20.7 min is greater than our study. This can be explained by greater loading dose of dexmedetomidine 1 μg/kg. In a study done by Kaya et al., they found the total duration of analgesia when using bolus dexmedetomidine 0.5 μg/kg to be 216 ± 43 which is more than our study observation of 196.01 ± 14.32 in Group B.

As shown in Table 3, in our study, 3 patients in Group B and 1 in Group I developed hypotension which was corrected by iv fluids and ephedrine 6 mg. Two patients in Group B and 1 patient in Group I had bradycardia which was successfully treated by iv atropine 0.6 mg. The incidence of side effects in both groups are comparable, and no severe side effects are encountered requiring treatment. As the doses are less, there is less incidence of side effects.[9,12] There is no sudden hypotension occur in this due to slow administration of the drug, and adequate hydration. Similar results are also found in Kaya et al.[7] No severe side effects were noted by others studies of Dinesh et al.,[10] Harsoor et al.,[11] and Al-Mustafa et al.[12]

Lee et al.[8] also found no significant side effects in their study although they used higher dose of dexmedetomidine (1 μg/kg).

**Conclusions**

From this study, the result we conclude that infusion of dexmedetomidine during intraoperative period prolonged postoperative analgesia with minimum side effects and added the advantage of sedation.

**Financial support and sponsorship**

Nil.

**Conflicts of interest**

There are no conflicts of interest.

**References**

1. Kanazi GE, Aoud MT, Jabbour-Khoury SI, Al Jazair MD, Alameddine MM, Al-Yaman R, et al. Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. Acta Anaesthesiol Scand 2006;50:222-7.
2. Mohamed AA, Fares KM, Mohamed SA. Efficacy of intrathecally administered dexmedetomidine versus dexmedetomidine with fentanyl in patients undergoing major abdominal cancer surgery. Pain Physician 2012;15:339-48.
3. Hanoura SE, Hassanin R, Singh R. Intraoperative conditions and quality of postoperative analgesia after adding dexmedetomidine to epidural bupivacaine and fentanyl in elective cesarean section using combined spinal-epidural anaesthesia. Anesth Essays Res [serial online] 2013;7:168-72. [cited 2017 Jul 02].
4. Soliman R, Eltaweel M. Comparative study of dexmedetomidine and fentanyl as an adjuvant to epidural bupivacaine for postoperative pain relief in adult patients undergoing total knee replacement: A randomized study. J Anesthesiol Clin Sci 2016;5:1. http://dx.doi.org/10.7243/2049-9752-5-1.
5. Esmaoglu A, Yegenoglu F, Akin A, Turky C. Dexmedetomidine added to levobupivacaine prolongs axillary brachial plexus block. Anesth Analg 2010;111:1548-51.
6. Ammar AS, Mahmoud KM. Ultrasound-guided single injection infraclavicular brachial plexus block using bupivacaine alone or combined with dexmedetomidine for pain control in upper limb surgery: A prospective randomized controlled trial. Saudi J Anaesth 2012;6:109-14.
7. Kaya FN, Yavascaoglu B, Turker G, Yildirim A, Gurbet A, Mogol EB, et al. Intravenous dexmedetomidine, but not midazolam, prolongs bupivacaine spinal anesthesia. Can J Anaesth 2010;57:39-45.
8. Lee MH, Ko JH, Kim EM, Cheung MH, Choi YR, Choi EM. The effects of intravenous dexmedetomidine on spinal anesthesia: Comparison of different dose of dexmedetomidine. Korean J Anaesthesiol 2014;67:252-7.
9. Reddy VS, Shaik NA, Donthu B, Reddy Sannaka VK, Jangam V. Intravenous dexmedetomidine versus clonidine for prolongation of bupivacaine spinal anaesthesia and analgesia: A randomized double-blind study. J Anaesthesiol Clin Pharmaco 2013;29:342-7.
10. Dinesh CN, Sai Tej NA, Yatish B, Pujiari VS, Mohan Kumar RM, Mohan CV. Effects of intravenous dexmedetomidine on hyperbaric bupivacaine spinal anesthesia: A randomized study. Saudi J Anaesth 2014;8:202-8.
11. Harsoor S, Rani DD, Yalamuru B, Sudheesh K, Nethra S. Effect of supplementation of low dose intravenous dexmedetomidine on characteristics of spinal anaesthesia with hyperbaric bupivacaine. Indian J Anaesth 2013;57:265-9.
12. Al-Mustafa MM, Badran IZ, Abu-Ali HM, Al-Barazangi BA, Massad IM, Al-Ghanem SM. Intravenous dexmedetomidine prolongs bupivacaine spinal analgesia. Middle East J Anaesthesiol 2009;20:225-31.
13. Thomas A, Satyaprakash M, Elakkumanan LB, Bidkar PU, Mishra SK. Comparison of different regimen of intravenous dexmedetomidine on duration of subarachnoid block. J Anaesthesiol Clin Pharmaco 2016;32:497-500.