

COMPARATIVE STUDY OF DIFFERENT DOSES OF DEXMEDETOMIDINE IN SPINAL ANAESTHESIA IN LOWER LIMB ORTHOPAEDIC PROCEDURES

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ABSTRACT: BACKGROUND AND OBJECTIVE: Spinal Anaesthesia is the most commonly used as it is very economical, easy to administer and safe. Dexmedetomidine, an alpha-adrenoreceptor agonist, is being used as a neuraxial adjuvant as it provides stable hemodynamic conditions, good quality of intra-operative and prolongs post-operative analgesia with minimal side effects. This study is aimed to assess the effect of intrathecal administration of different doses of dexmedetomidine with hyperbaric bupivacaine on the duration of sensory and motor block, side effects produced by spinal anaesthesia in lower limb orthopaedic surgeries. **METHODS AND MATERIALS:** A randomized double blind study is planned in 90 patients divided in 3 groups. Group A, B and C patients received inj. Bupivacaine (12.5mg) with normal saline, with dexmedetomidine (5µg) and with dexmedetomidine (10 µg) respectively. Hemodynamic data were recorded after every 5 min for 30 minutes than after every 15 min. Degree of motor block (Bromage 1), sensory block, time of regression of sensory block, side effects were assessed. **RESULT:** Dexmedetomidine (10 µg) prolonged time for two segment regression. Effect was greater in group C (Dex 10 µg) than group B (Dex 5 µg) as well as higher sedation scores achieved intraoperatively. Hemodynamic stability was maintained in all the three groups. **CONCLUSION:** Dexmedetomidine in different doses prolongs the anaesthetic effect of intrathecal hyperbaric bupivacaine. A 10 µg dose may be of benefit for prolonged duration of surgery. **KEYWORDS:** Dexmedetomidine, dose dependent; Bupivacaine, Intrathecal.

INTRODUCTION: Lower limb injuries are often with multiple fragmented bones and crush injuries of muscle fibres. Repair of such cases may take time which is usually unpredictable, and to prolong the duration of subarachnoid block various intrathecal adjuvants have gained popularity which aim to not only prolong the duration and onset of action, but for better success rate, faster recovery and minimal side effects.

Dexmedetomidine is highly selective α_2 adrenergic agonist. Drug has been used as intrathecally as an adjuvant and no neurological side-effect is reported in humans. It also provides stable hemodynamic condition, good quality of intra-operative and prolonged post-operative analgesia with minimal side effects. Intrathecal α_2 receptor agonists are found to have antinociceptive action for both somatic and visceral pain.

The study aims to determine the effect of adding dexmedetomidine to hyperbaric bupivacaine and comparing with bupivacaine alone for neuraxial anaesthesia and post-operative analgesia.

MATERIALS AND METHODS: After approval of the study from the Ethical committee of the University of Mahatma Gandhi Medical College and Hospital Jaipur and informed consent this prospective randomized double blind study was conducted with 90 consenting patients of ASA grade

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I and II, scheduled for lower limb orthopaedic surgeries. Using the sealed envelope method, the patients were randomly allotted into 3 groups, 30 patients in each group.

Group BS

Group BD1

Group BD2

The surgeon, patient and the observing anaesthesiologist were blinded to the patient group.

EXCLUSION CRITERIA:

- Any contra-indication to spinal anaesthesia like hypotension, coagulation defects, spine abnormalities etc.
- Body weight ≥ 120 kg and height ≤ 150 cm.
- Patients with labile hypertension, heart block, arrhythmias.
- Patients on calcium channel blockers, adrenergic receptor blockers, ACE inhibitors.
- Allergic to the drug.

All patients received drug volume of 3 ml containing 2.5 ml (12.5 mg) hyperbaric bupivacaine hydrochloride. The study groups received dexmedetomidine 5 μ g (group BD1) or 10 μ g (BD2) diluted to 0.5ml with 0.9% saline, added to bupivacaine in the same syringe. The control group BS received an identical volume of 0.9% saline added to bupivacaine. Standard monitoring with non-invasive BP, HR and ECG were started. The patients were preloaded with RL solution 15ml/kg. Patients were placed in sitting position and lumbar puncture was performed at L3-4 interspace through a midline approach using a 25 gauge quincke needle under strict asepsis.

Heart rate, MABP and oxygen saturation were monitored and recorded after the block every 5 minutes for half an hour then every 15 minutes until the end of surgery. The level of sensory block was assessed (By a blinded anaesthetist not involved in this study) by pin prick sensation using a blunt 25 gauge needle along the mid clavicular line bilaterally. The times from intrathecal injection to two dermatome sensory regression, sensory regression to S1 dermatome, and motor block regression to Bromage 1 were recorded.

The motor level will be assessed according to modified bromagescale: Bromage;

- 0 – able to move hip, knee and ankle.
- 1 – unable to move the hip
- 2 – unable to move the hip and knee
- 3 – unable to move the hip, knee and ankle.

The hemodynamic variables were recorded before spinal anaesthesia and there after every 5 minutes for half an hour, then every 15 minutes until the end of procedure and PACU.

A decrease of $\geq 20\%$ from base line or less than 90 mmHg in systolic blood pressure, was defined as hypotension was treated with 5 mg intravenous ephedrine and a bolus administration of 500 ml of RL solution over 20 minutes. Bradycardia was defined as HR ≤ 50 beats/ minute and was treated with 0.6mg atropine.

STATISTICAL TESTS:

- Student t test and ANOVA test for parametric data.
- Chi square test for non-parametric data.

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RESULTS: 90 patients were enrolled into the study. The groups were comparable with respect to age, weight, height, effect distribution and operative time. Sedation score and hemodynamic data did not differ significantly among the groups.

The duration of sensory block was significantly prolonged in the group receiving intrathecal dexmedetomidine as adjuvant as compare to the group receiving local anaesthetic alone. The mean sensory block duration in BD1 group and BD2 was significantly prolonged.

Respiratory distress and pruritus was not reported in any of the patient among all the groups, had peripheral oxygen saturation $\geq 95\%$ and did not required oxygen administration in PACU.

Demographic data	Plane	5d	10d	P Value
Age	38.2+_ 12.5	37.4+_ 10.1	38.3+_11.6	NS
Male	16	15	16	NS
Female	14	15	14	NS
ASA I	25	24	24	NS
ASA II	5	6	6	NS
Height	157+_ 6	159+_5	158+_5	NS
Weight	64+_7	65+_4	63+_5	NS

Variable(min)	Plane	5d	10d	P value
Time of onset of sensory block	7.8+_1.8	8.3+_2.8	8.3+_2.4	0.113
Time of onset of motor block	9.2+_2.9	9.8+_3.6	9.7+_3.2	0.086
Time to reach maximum sensory level	10.1+_3.5	9.5+_3.0	10.3+_3.3	3.32
Duration of sensory block	102.3+_17.2	117.0+_21.8	146.7+_20.5	0.0001
Duration of motor block	161.5+_19.8	198.7+_26.4	273.3+_24.6	0.0001
Duration of spinal anaesthesia	183.0+_31.0	242.3+_54.2	295.5+_44.3	0.0001

VAS < 3 was observed in all the groups intra operatively and there was no need for additional analgesic throughout the surgery. Post-operative VAS and total analgesic requirement in 24 hours were minimal in group BD2 as compare to BD1 group.

All the patients achieved modified Bromage scale 3 motor block and there was dose dependent prolongation of motor block in BD1 and BD2 groups. Similarly regression of motor block to modified Bromage 0 was significantly prolonged in group BD2 than BD1 and BS group. Complete recovery of sensory and motor functions was observed in all the patients.

At first post-operative visit, 15 days after surgery the patients were evaluated and none of them had neurological deficit.

DISCUSSION: Dexmedetomidine is $\alpha 2$ adrenoreceptor agonist. It acts by depressing the release of C-fibres transmitter and by hyperpolarization of post synaptic dorsal horn neuron, which produces analgesia. (Correa-Saler C, Rabin BC, Maze M)

DXM and clonidine both is $[\alpha]$ 2-adrenoreceptor agonist agents initially prescribed for hypertension and intravenous sedation. Gradually the role of these two agents extended beyond wards to operation theatre for the provision of intraoperative and postoperative analgesia and sedation.

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Van Tuijl I,⁽¹⁾ added various doses of clonidine (0, 15 or 30 µg) to 5 mg hyperbaric bupivacaine and evaluated their effect on the duration of the motor block, analgesic quality and ability to void. They opined that addition of 15 and 30 µg of clonidine increased the motor block duration by 25 and 34 min, respectively and also resulted in better analgesic quality.

Hutschala D, Mascher H⁽²⁾ added clonidine to bupivacaine and found that it enhances and prolongs analgesia after brachial plexus block via a local mechanism in healthy volunteers.

Niemi L⁽³⁾ studied effects of intrathecal clonidine on duration of bupivacaine spinal anesthesia, hemodynamics, and postoperative analgesia in patients undergoing knee arthroscopy and found that intrathecal clonidine significantly prolongs the anesthetic and analgesic effects of bupivacaine.

Kalso A⁽⁴⁾ reported that as compared to clonidine, the affinity of DXM to [alpha] 2 receptors is ten times greater. Results of our study showed that addition of dexmedetomidine to bupivacaine although delays onset but, significantly prolongs the duration of sensory and motor block.

Mahmoud M. Al-Mustafa⁽⁵⁾ added dexmedetomidine to spinal bupivacaine for urological procedures. He compared 5mcg (Group D 5) and 10 mcg (Group D 10) of dexmedetomidine added to 12.5 mg bupivacaine to bupivacaine 12.5 mg with normal saline (Control group). The author found that the mean time of sensory block to reach T10 dermatome was 4.7±2.0 minute in D10 group, 6.3±2.7 minute in D5 group and 9.5± 3.0 minute in control group. The mean time to reach Bromage 3 scales was 10.4±3.4 minute in D10 group, 13.0±3.4 minute in D5 group and 18.0 ± 3.3 minute in control group. Regression time to reach S1 dermatome was 338.9±44.8 minute in D10 group, 277.1±33.2 minute in D5 group and 165.5 ± 32.9 minute in control group. Time to reach Bromage 0 was 302.9±36.7 minute in D10 group, 246.4.1±24.7 minute in D5 group and 140.1 ± 32.3 minute in control group. They found that dexmedetomidine has dose dependent effect on onset and regression of sensory and motor block.

Subhi M. Al-Ghanem,⁽⁶⁾ evaluated the onset and duration of sensory and motor block as well as operative analgesia and adverse effects of dexmedetomidine (5 µg) or fentanyl (25 µg) given intrathecally with plain 0.5% bupivacaine (10mg) for spinal anesthesia. Patients in dexmedetomidine group (D) had significant longer sensory and motor block as compared to patients in fentanyl group (F). The time to reach the maximal sensory block was 19.34± 2.87 min. for group D and 18.39 ±2.46 min. for Group F (p = 0.126) The onset time of modified Bromage 3 motor block was also not different between group D and F; 14.4± 6.7 and 14.3 ±5.7 min. respectively (P = 0.93). The mean time of sensory regression to S1 was 274±73 min in group D and 179±47 min in group F (P < 0.001). The regression time of motor block to reach modified Bromage 0 was 240±60 min in group D and 155±46 min in group F (P< 0.001). Hypotension was mild to moderate in both groups except one patient in group F, who had a blood pressure less than 90 mmHg, and required 36 mg ephedrine to restore his blood pressure.

They concluded that in women undergoing vaginal reconstructive surgery under spinal anaesthesia, 10 mg plain bupivacaine supplemented with 5 µg (microgram) dexmedetomidine produces prolonged motor and sensory block compared with 25 µg fentanyl. Duration of motor block was also prolonged with clonidine added to bupivacaine (172.11±29.77 min for group A, 231.93±70.57min for group B).

Nikhil Kothari, Jaishri Bogra⁽⁷⁾ studied 210 ASA I-II pregnant females undergoing emergency cesarean section. In group I (n=70) patients received 12.5 mg of 0.5% hyperbaric bupivacaine intrathecally. In group II (n=70) patients received intrathecal mixture of 0.5% hyperbaric

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bupivacaine (8 mg) and clonidine 50 µg. In group III (n=70), patients received 0.5% hyperbaric bupivacaine (10 mg) intrathecally along with 50 µg of clonidine. Patients receiving intrathecal clonidine along with bupivacaine had significantly long lasting analgesia with lower bupivacaine dose [246.21±5.15 min. (Group II) vs 146.0±4.55 min (Group I), P=0.021; 95% confidence interval: 238.01-257.40, group II and 134.99-157.0 groups I].

Strebel S et al.^[8] examined the dose-response relationship of intrathecal clonidine at small doses (≤ 150 µg) with respect to prolonging bupivacaine spinal anesthesia. Eighty orthopedic patients were randomly assigned to receive 18 mg of isobaric 0.5% bupivacaine intrathecally plus saline (Group 1), clonidine 37.5 mcg (Group 2), clonidine 75mcg (Group 3), and clonidine 150mcg (Group 4). Duration of the sensory block (regression below level L1) was increased in patients receiving intrathecal clonidine, 288 ±62 min (Group 1, control), 311 ± 101 min in Group 2, 325± 69min in Group3, and 337±78min in Group 4. They concluded that small doses of intrathecal clonidine (≤ 150 µg) significantly prolongs the anesthetic and analgesic effects of bupivacaine in a dose-dependent manner.

Studies conducted by Kaabachi et al.⁽⁹⁾ Elia et al,⁽¹⁰⁾ Saxena et al,⁽¹¹⁾ B. S. Sethi et al,⁽¹²⁾ Cao JP⁽¹³⁾ similarly showed that addition of various doses of clonidine to bupivacaine intrathecally significantly prolongs duration of analgesia of bupivacaine.

When we compared the dexmedetomidine in different doses, we found that onset of motor block and sensory block was delayed as compared to control group. The difference was statistically insignificant. Higher dose of Dexmedetomidine produced significantly longer duration of sensory and motor block as compared to low dose.

Sukhminderjit Singh Bajwa⁽¹⁴⁾ compared Dexmedetomidine and clonidine in epidural anaesthesia. The patients were randomly allocated into two groups; ropivacaine + dexmedetomidine (RD) and ropivacaine + clonidine (RC), comprising of 25 patients each. Group RD was administered 17 ml of 0.75% epidural ropivacaine and 1.5 µg/kg of dexmedetomidine, while group RC received admixture of 17 ml of 0.75% ropivacaine and 2 µg/kg of clonidine. They concluded that addition of dexmedetomidine to ropivacaine as an adjuvant resulted in an earlier onset (8.52 ± 2.36 min) of sensory analgesia at T 10 level as compared to the addition of clonidine (9.72 ± 3.44 min). Dexmedetomidine not only provided a higher dermatomal spread but also helped in achieving the maximum sensory anaesthetic level in a shorter period (13.14 ± 3.96 min) compared to clonidine (15.80 ± 4.86 min). Modified Bromage scale 3 was achieved earlier (17.24 ± 5.16 min) in patients who were administered dexmedetomidine as adjuvant.

G. E. Kanazi⁽¹⁵⁾ studied the effect of low-dose dexmedetomidine or clonidine on hyperbaric bupivacaine. In a prospective, double-blind study, 60 patients undergoing transurethral resection of prostate or bladder tumor under spinal anesthesia were randomly allocated to one of three groups. Group B patients received 12 mg of hyperbaric bupivacaine, group D patients received 12 mg of bupivacaine supplemented with 3mg of dexmedetomidine and group C patients received 12 mg of bupivacaine supplemented with 30 mg of clonidine. The mean time of sensory regression to the S1 segment was 303 ± 75 min in group D, 272 ± 38 min in group C and 190 ± 48 min in group B (B vs. D and B vs. C, P < 0.001). The regression of motor block to Bromage 0 was 250 ± 76 min in group D, 216 ± 35 min in group C and 163 ± 47 min in group B (B vs. D and B vs. C, P < 0.001). They opined that dexmedetomidine (3 mg) or clonidine (30 mg), when added to intrathecal bupivacaine, produces a similar prolongation in the duration of the motor and sensory block with preserved hemodynamic

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stability and lack of sedation. In our study patient remained hemodynamically stable with dexmedetomidine in different doses.

CONCLUSION: Supplementation of spinal bupivacaine with dexmedetomidine significantly prolonged both sensory and motor block compared with intrathecal bupivacaine alone. Patients in the groups that received dexmedetomidine had reduced post-operative pain scores and a longer analgesic duration than those who received spinal bupivacaine alone.

REFERENCES:

1. Van Tuijl I, Giezeman MJ, Braithwaite SA, Hennis PJ, Kalkman CJ and van Klei WA (2008). Intrathecal low-dose hyperbaric bupivacaine-clonidine combination in outpatient knee arthroscopy: a randomized controlled trial. Publication date and source *Acta Anaesthesiol Scand* 52 (3) 343-349.
2. Hutschala D, Mascher H, Schmetterer L, Klimscha W, Fleck T, Eichler HG, Tschernko EM (2004). Clonidine added to bupivacaine enhances and prolongs analgesia after brachial plexus block via a local mechanism in healthy volunteers. *European Journal of Anaesthesiology* 21 (3) 198-204.
3. Niemi L (1994). Effects of intrathecal clonidine on duration of bupivacaine spinal anesthesia, hemodynamics, and postoperative analgesia in patients undergoing knee arthroscopy. *Acta Anaesthesiol Scand* 38:724-728.
4. Kalso E, Poyhia R and Rosemberg P (1991). Spinal antinociceptive by dexmedetomidine a highly selective 2-adrenergic agonist. *Pharmacology Toxicology* 68 140-143.
5. Mahmoud Al-Mustafa, Semi A, Abu-halaweh, AbdelKarem S, AloweidiMujalli, Murshidi M, Bassam A Ammari, Ziad M Awwad, Ghazi M Al –Edwan and Micheal M Ramsay (2009). Effect of dexmedetomidine added to spinal bupivacaine for urological procedures. *Saudi Medical Journal* 30 (3) 365-370.
6. Subhi M Al-Ghanem, Islam M Massad, Mahmoud M Al-Mustafa, Khaled R Al-Zaben, Ibrahim Y Qudaisat, Ayman M Qatawneh and Hamdi M Abu-Ali). Effect of adding dexmedetomidine versus Indian *Journal of Fundamental and Applied Life Sciences* ISSN: 2231-6345 (Online) An Online International Journal Available at <http://www.cibtech.org/jls.htm> 2012October-December; 2 (4): 24-33.
7. Nikhil Kothari, Jaishri Bogra and Ajay K Chaudhary (2011). Evaluation of analgesic effects of intrathecal clonidine along with bupivacaine in caesarean section. *Saudi Journal of Anaesthesiology* 5 (1): 31-35.
8. Strebel S, Gurzeler JA, Schneider MC, Aeschbach A and Kindler CH (2004). Small-dose intrathecal clonidine and isobaric bupivacaine for orthopedic surgery: a dose-response study. *Anesthesia and Analgesia* 99 (4): 1231-1238.
9. Kaabachi O, Zarghouni A, Ouezini R, Abdelaziz AB, Chattauoui O, Kokki H (2007). Clonidine 1mcg/kg is a safe and effective adjuvant to plain bupivacaine in spinal anaesthesia in adloscents. *Anesthesia and Analgesia* 105; 51-69.
10. Elia N, Culebras X, Mazza C, Schiffer E and Tramer MR. Clonidine as an adjuvant to intrathecal local anaesthetics for surgery: Systematic review of randomized trials. *Regional Anesthesia and Pain Medicine* 33 (2): 159-167.

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11. Saxena M, Singh S and Ghildiyal S (2010). Low dose intrathecal clonidine with bupivacaine improves onset and duration of block with haemodynamic stability. *The Internet Journal of Anaesthesiology* 23 (1).
12. Sethi BS, Samuel M, Sreevastava D (2007). Efficacy of analgesic effect of low dose intrathecal clonidine as adjuvant to bupivacaine. *Indian Journal of Anaesthesia* 51 (5); 415-419.
13. Cao JP, Miao XY, Liu J and Shi XY (2011). An evaluation of intrathecal bupivacaine combined with intrathecal or intravenous clonidine in children undergoing orthopedic surgery: a randomized double-blinded study. *Pediatric Anesthesia* 21 (4); 399-405.
14. Sukhminder Jit Singh Bajwa, Sukhwinder Kaur Bajwa, Jasbir Kaur, Gurpreet Singh, Vikramjit Arora, Sachin Gupta, Ashish Kulshrestha, Amarjit Singh, SS Parmar, Anita Singh and SPS Goraya (2011). Dexmedetomidine and clonidine in epidural anaesthesia: A comparative evaluation. *Indian Journal of Anaesthesia* 55 (2); 116-121.
15. Kanazi GE, Aouad MT, Jabbour-Khoury SI, Al Jazzar MD, Alameddine MM, Al-Yaman R, Bulbul M and Baraka AS (2006). Effect of low-dose dexmedetomidine or clonidine on the characteristics of bupivacaine spinal block. *Acta Anaesthesiologica Scandinavica* 50 (2); 222-227.

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