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ORIGINAL ARTICLE

Lumber Plexus Block for Postoperative Analgesia: Effect of Adding Low Dose Dexmedetomidine to Ropivacaine

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ABSTRACT

Introduction: Our aim is to assess the effect of adding 0.5µg/kg dexmedetomidine to 0.33% ropivacaine in lumbar plexus block (LPB) on postoperative analgesia and opioid consumption. This dose and concentration has not been used in LPB in previous studies.

Materials and methods: This study enrolled 60 patients scheduled for hip surgery to receive either 32 mL of study drug which consisted of 30mL of ropivacaine 0.33% and 2 mL of Normal saline [Group RN (n = 30)] or 30 mL solution, in which dexmedetomidine 0.5 µg/kg was diluted in normal saline to reach a total volume of 2 mL and added to 30 mL of ropivacaine 0.33% Group RD (n = 30) before induction of general anesthesia. Postoperative analgesia was assessed with visual analog scale (VAS) scoring at 0,2,4,8,12,18,24 hours and patient satisfaction score(PSS) at 24 hour. Hemodynamic parameters were monitored perioperatively. Mann–Whitney U-test was applied for VAS and sedation scores. Unpaired t-test was applied for age, weight, duration of surgery and duration of post operative analgesia.

Results: Sixty patients were analyzed. There was significant reduction in pain scores in Group RD compared to RN upto 8 hours postoperatively. Duration of analgesia was significantly increased in Group RD, 502 ±102 as compared to Group RN, 250 ± 116. Total analgesic requirement in form of opioid was also reduced by dexmedetomidine in first 24-hour. There was no difference in hemodynamic parameters and sedation scores throughout the study among both groups with nil complication.

Conclusion: Low dose dexmedetomidine as an adjuvant to ropivacaine prolongs the time for first analgesic requirement and reduces the total postoperative opioid consumption without major side effects.

Clinical significance: Limiting the dose of dexmedetomidine 0.5 µg/kg and ropivacaine concentration to 0.33% in combination, not only prolong duration of analgesia but also avoid undesirable side effects.

Keywords: Dexmedetomidine, Lumbar plexus block, Postoperative analgesia

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INTRODUCTION

Postoperative pain following hip surgeries, not only prolongs hospitalization but impairs early mobilization[1] and rehabilitation,[2] contributing to higher incidences of cardiopulmonary complications[3] thus may deteriorate postoperative outcome.[4] LPB for lower limb surgeries reduces both postoperative pain and additional opioid requirement.[5] Recent researches showed that ropivacaine and bupivacaine, could extend postoperative analgesia about 8 to 14 hours.[6-9] Dexmedetomidine, the most recent two adrenergic agonist, has been studied to increase the duration of peripheral nerve block when added to local anaesthetic agents.[10-12] This randomized study aimed to report the effect of adding low dose dexmedetomidine to minimal required concentration of ropivacaine for LPB for postoperative analgesia.

MATERIALS AND METHODS

This double blind randomized prospective clinical study was approved by Hospital Ethics Committee and carried out on 60 patients of American Society of Anesthesiologist physical status (ASA) Grade I and II, of either sex, aged 18 to 50 years undergoing elective unilateral hip surgeries under general anaesthesia. Exclusion criteria were patient refusal, patients with significant cardiac, respiratory, hepatic, renal, metabolic disorder, chronic hypertension, bradycardia, severe hypovolumia, coagulation abnormalities, infection at block site, psycholocal disorders, allery to study medications and chronic use of pain killers or adrenoceptors agonists or antagonists and any patient who required postoperative ventilation.

These patients were allocated randomly into two groups according to study drugs as follows: Group RN (n = 30) received LPB using 32 mL of study drug which consisted of 30 mL of ropivacaine 0.33% and 2 mL of normal saline while Group RD (n = 30) patients received LPB with 30 mL solution, in which dexmedetomidine 0.5 µg/kg was diluted in normal saline to reach a total volume of 2 mL and added to 30 mL of Ropivacaine 0.33%.

All patients were premedicated with intra muscular glycopyrrolate 0.2 mg, 30 min before induction

of anesthesia. After securing intravenous (IV) access, patients were monitored by measuring heart-rate (HR), electrocardiography (ECG), noninvasive blood pressure (NIBP), respiratory rate (RR), peripheral oxygen saturation (SpO_2), temperature with Schillers multipara monitor. Basal values were noted before performing LPB. Patients were asked to take lateral decubitus position with operative side up. Under all aseptic technique, skin area of interest was anaesthetized with 2 mL of 1% lidocaine, infiltrated subcutaneously. LPB was performed using Winne's[13] approach with an insulated 10 cm, 21 G needle. The nerve stimulator (plexygon/vygon) was connected with the cathode to the insulated short beveled stimulating needle and the anode to a solid gel skin electrode on the ipsilateral mid thigh. The nerve stimulator set initially to deliver a current of 1.5 mA and 0.1 ms impulse. The lumbar plexus site was confirmed by contraction of quadriceps muscle and patella with a current less than 0.5 mA at 1 Hz, then after negative aspiration, study drugs were injected by a person who was not aware of allocation of groups. Twenty minutes after completion of block the area of incision was tested for sensory block by pinprick discrimination using hypodermic needle 23 G. General anesthesia was standardized for all patients in both groups by an anesthesiologist blinded to group allocation. After preoxygenation with 100 % oxygen, inj fentanyl 2 µg/kg and inj propofol 2 mg/kg was injected. Trachea was intubated with inj suxamethonium 2 mg/kg and anesthesia was maintained on O_2:N_2O (66:33), Isoflurane (1 MAC), and inj vecuronium loading 0.1 mg/kg and intermittent doses of 0.01 mg/kg throughout the surgical procedure. Inj fentanyl 1 µg/kg was kept ready for any intraoperative rise in HR or mean arterial pressure (MAP) above 20% of baseline value. HR and MAP were recorded pre block and every 30 min intraoperatively until surgery was completed. Numbers of intraoperative rescue fentanyl boluses were documented. After completion of surgery, reversal of neuromuscular blocking agent and patients were extubated. All patients were transferred to anesthesia intensive care unit (AICU) where they stayed until they met the hospital discharge criteria. Postoperative pain defined as VAS–10 cm scale where 0 = no pain and 10 = worst pain). Pain score of 4 or more or patient request for additional analgesics, was treated with rescue analgesia in the form of injection tramadol 100 mg administered by blinded nursing staff. The time from the end of the LPB to the first analgesic request was defined as the duration of analgesia. Total numbers of rescue opioids were recorded in both the groups.

Duration of analgesia, severity of pain (at rest) VAS scores and sedation score was recorded at AICU admission 0, 2, 4, 8, 12, 18 and 24 hour.

Sedation score was assessed by using Brussels sedation score:[14]

1 = Unarousable
2 = Respond to pain stimulation
3 = Responds to auditory stimulation
4 = Awake and calm
5 = Agitated

Patient satisfaction score was also recorded on a VAS scale (10 cm scale where 0 = least satisfied and 10 = most satisfied) at 24h postoperatively.

Bradycardia (HR < 50 beats per minute), hypotension (the decrease of MAP > 20% baseline value), hypoxemia (SpO_2 < 90%), nausea and vomiting were defined as side-effects.

DISCUSSION

This prospective randomized controlled trial demonstrates that the addition of low dose 0.5 µg/kg dexmedetomidine to low concentration 0.33% ropivacaine in LPB is an effective local anaesthetic-adjunct combination, capable of prolonging duration of analgesia and reducing cumulative analgesic consumption at 24 hour. Ropivacaine acts on voltage dependent Na^+ channels. It is less cardiac and central nervous system toxic than bupivacaine. Dexmedetomidine is highly selective α-2 receptor agonist which possess sedative, analgesic, anaesthetic sparing effects and sympatholytic properties and gives prolonged analgesia when used as an adjuvants to peripheral nerve blocks without respiratory depression.[15-17]

Dexmedetomidine has been studied, in several doses in different upper limb peripheral nerve blocks. Very few studies has been carried out in lower limb blocks with dexmedetomidine. Various doses, ranged from 0.5 µg/kg to 2 µg/kg along with bupivacaine, levobupivacaine or ropivacaine in variable concentration has been used.[18] We decided to choose 0.5 µg/kg in our study.

The study of Stevens et al.[18] showed when single injection LPB under general anaesthesia compared with patients received general anaesthesia only, total opioid requirement were reduced significantly up to 6 hour after total hip arthroplasty. Touray et al.[19] described 8 hour of postoperative lower pain scores and morphine consumption following single injection LPB for hip arthroplasty. Chelly and Siddiqui et al.[20] described continuous LPB for hip surgeries could be used to reduce rescue opioids.

Keplinger et al.[21] found, different doses (50, 100 and 150 µg) dexmedetomidine as an adjuvant to ropivacaine for ulnar nerve block, dose dependently increase duration of sensory block and provide moderate sedation. No sedation was noted with 0.5 µg/kg of dexmedetomidine in our study. Furthermore, Esmaoglu et al.[22] concluded that 100 µg dexmedetomidine added to 0.5% levobupivacaine shortens the onset time and prolong the duration of axillary brachial plexus block but may also lead to bradycardia. Brummett et al.[23] studied effect of adding

dexmedetomidine to ropivacaine for sciatic nerve block. He concluded duration of analgesia was increased by dexmedetomidine as it blocked the hyperpolarization-activated cation current. Another perineural mechanism may be peripheral vascular contraction. Dexmedetomidine may cause contraction of perineural vessel by coupling with α2B adrenergic receptor, reduce the absorption of local anesthetics and then prolong the duration of analgesia. Centrally acting α2-adrenergic receptor agonists inhibit release of substance P in the pain pathway at the level of dorsal root neuron and activate α2-adrenergic receptor in the locus coeruleus.

The effect of sedation may be mainly produced in a central mechanism which has been confirmed by Guo et al.[24] Sedative effects of dexmedetomidine is mainly attributed to inhibition of noradrenalin release from noradrenergic neurons, situated in locus ceruleus. However, Chun Guang Wang[25] Demonstrated perineural administration of 1 µg/kg dexmedetomidine with 0.5% ropivacaine in LPB led to moderate sedation from 45 to 120 mins after injection. In our research we did not find any episode of bradycardia and sedation in any group as dose and concentration both had been reduced.

At high doses dexmedetomidine is associated with some side effects such as hypotension, bradycardia, and sedation.[26] Hesham F Soliman reported a significant fall in the HR 120 min postinduction to 4 hours postoperatively in the Dexmedetomidine group (1 µg/kg).[27] Similar to the HR, increased sedation was noticed in the first postoperative 4 hour among group BD patients. Dose of 0.5 µg/kg of dexmedetomidine appeared to be safe in this study as MAP and HR were not changed throughout the study. Not a single case of bradycardia or hypotension was reported. This dose was appeared safe with respect to sedation also. Swami et al. reported significant reduction ($p < 0.001$) in hemodynamic parameters with 1 µg/kg dexmedetomidine this also proved that dose of 0.5 µg/kg could be chosen to avoid circulatory and other side effects.[28] Limitation of our was that we assessed only analgesia enhancing action of dexmedetomidine but no objective assessments of motor and sensory block onset times and duration were made.

Statistical Analysis

Data were expressed as mean values ± standard deviation/standard error, percentages (%), and numbers (n). The statistical analysis was performed by a statistician using Windostat Version 9.2.

Mann–Whitney U-test was applied for VAS and sedation scores. Unpaired t test was applied for age, weight, duration of surgery and duration of post operative analgesia.

The value p-value < 0.05 was considered as statistically significant while $p < 0.01$, highly significant and $p < 0.001$, very highly significant.

RESULTS

The demographic data and operative data were similar in each group (Table 1; $p > 0.05$). There were 5 failed blocks which were not included in this study. None of the patients in both groups required intraoperative rescue fentanyl boluses. The duration of postoperative analgesia was significantly longer (502 ± 102 vs 250 ± 116.2 min) almost double in group RD than group RN (Table 2A; $p < 0.05$). Total consumption of rescue analgesic was less in RD group than RN group. HR and MAP at different intervals were slightly lower in RD group but statistically insignificant throughout the surgery and postoperatively. No other side-effects such as bradycardia, hypotension, hypoxemia, nausea and vomiting were noted in each group. Difference in hemodynamic changes were neither clinically nor statistically significant. Sedation scores in postoperative period among both the groups were comparable. As regards the VAS for postoperative pain upto 8hrs significantly better in RD group, than RN group ($p < 0.05$). Patient satisfaction score at 24 hour was statistically significant in group RD than group RN.

Table 1: Patient and surgical characterstics

Characterstic	*Group RN*	*Group RD*
Age (Years)	42 ± 9.17	43.8 ± 11.3
Sex (M/F)	26/4	25/5
Weight (Kg)	52.46 ± 8	53.07 ± 7.9
Height (Cm)	175.8	176.7
Duration of surgery (min)	154.0	156.0

Table 2: Postoperative outcomes

(A) Time for first analgesic request (DOA): Mean ± SD

	Group RN	*Group RD*	*p-value*
DOA (min)	250 ± 116.2	502 ± 102	< 0.001

(B) Pain score on the VAS (Mean ± SD)

Interval	*Group RN*	*Group RD*	*p-value*
0 hour	0.74 ± 0.60	0.06 ± 0.24	< 0.001
2 hours	2.28 ± 0.61	0.34 ± 0.54	< 0.001
4 hours	3.32 ± 0.71	0.82 ± 0.96	< 0.001
8 hours	2.06 ± 0.74	1.18 ± 0.66	< 0.001
12 hours	0.36 ± 0.48	0.32 ± 0.47	0.674
18 hours	0.36 ± 0.56	0.32 ± 0.48	0.946
24 hours	0.18 ± 0.15	0.20 ± 0.40	0.799

(C) VAS score for patient satisfaction at 24 hour postoperatively

VAS score at 24 hour	*Group RN*	*Group RD*	*p-value*
	7	5	< 0.001

CONCLUSION

The addition of dexmedetomidine in low dose 0.5 µg/kg to minimal concentration of ropivacaine (0.33%) for

lumbar plexus block is safe and effective in improving postoperatively analgesia without sedation and any side effect.

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