Original Article

Dexmedetomidine as an additive to local anesthetics compared with intravenous dexmedetomidine in peribulbar block for cataract surgery

ABSTRACT

Background: No studies compared parenteral dexmedetomidine with its use as an adjuvant to ophthalmic block. We compared between adding dexmedetomidine to bupivacaine in peribulbar block and intravenous (IV) dexmedetomidine during peribulbar block for cataract surgery.

Materials and Methods: A prospective, randomized, double-blind study on 90 patients for cataract surgery under peribulbar anesthesia. Study included three groups; all patients received 10 ml of peribulbar anesthesia and IV infusion of drugs as follows: Group I: Received a mixture of bupivacaine 0.5% (4.5 ml) + lidocaine 2% (4.5 ml) + normal saline (1 ml) + 150 IU hyaluronidase + IV infusion of normal saline, Group II: Received mixture of bupivacaine 0.5% (4.5 ml) + lidocaine 2% (4.5 ml) + dexmedetomidine 50 μg (1 ml) +150 IU hyaluronidase + IV infusion of normal saline and Group III: Received mixture of bupivacaine 0.5% (4.5 ml) + lidocaine 2% (4.5 ml) + normal saline (1 ml) +150 IU hyaluronidase + IV dexmedetomidine 1 μg/kg over 10 min; followed by 0.4 μg/kg/h IV infusion. We recorded onset, duration of block, Ramsay Sedation Score, intra-ocular pressure (IOP), hemodynamics, and adverse effects.

Results: There was a significant decrease in the onset of action and increase in the duration of block in Group II as compared with the Group I and Group III. Mean Ramsay Sedation Score was higher in Group III. The IOP showed a significant decrease in Group II and Group III 10 min after injection ($P < 0.01$). Heart rate showed a significant decrease in Group III in comparison with the two other groups ($P < 0.05$). Only two patients in Group III developed bradycardia.

Conclusion: Dexmedetomidine as an additive shortens onset time, prolong block durations and significantly decreases the IOP with minimal side effects. IV dexmedetomidine, in addition, produces intra-operative sedation with hemodynamic stability.

Key words: Cataract surgery; dexmedetomidine; peribulbar block

Introduction

Ocular surgery may be performed under topical, regional or general anesthesia. The first recorded use of regional anesthesia for surgery was the instillation of cocaine into the conjunctival sac in 1884 by an Austrian ophthalmologist.[1]

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Recently, a major change in anesthetic practice has taken place, and the majority of ophthalmic surgical patients now undergo regional rather than general anesthesia. This change has been driven in part by the pressure to undertake surgical procedures as day cases, regional anesthesia is more economic, easy to perform, and the risk involved is less. Orbital regional anesthesia can be done using a retrobulbar (intra-conal) block peribulbar (extra-conal) block or sub-Tenon's block.

Davis and Mandel[2] in 1986 described the peribulbar block, peribulbar block has delayed onset and need a higher volume of local anesthetic (LA) than a retrobulbar block. But peribulbar block is away from intra-conal space and so produce fewer complication.[3,4]

Many additives such as clonidine, hyaluronidase, sodium bicarbonate, muscle relaxants, and opioids were added to LAs drugs in the ocular block for rapid the onset and long the duration of analgesic effect of LA.[5-8]

Dexmedetomidine is a selective alpha two adrenoreceptor agonist. It provides dose-dependent sedation, analgesia, sympatholysis, and anxiolysis without relevant respiratory depression.[9] Now, dexmedetomidine is used as adjuvant to LA drugs in peripheral nerve block, brachial plexus block and intrathecal anesthesia with satisfactory results.[10] Our study aimed to compare between intravenously (IV) administered dexmedetomidine and its use as an additive to LA for peribulbar block. The comparison focused on the efficacy and safety of dexmedetomidine in either situation.

Materials and Methods

This prospective randomized, double-blind, and controlled study was conducted on 90 patients American Society of Anesthesiologists I and II, age ranged between 28 and 65 years and scheduled for eye surgery under local peribulbar anesthesia.

Patient informed written consent and Local Ethical Committee approval have been obtained before patient's allocation.

Exclusion criteria included age younger than 18 years, the usual contraindications for regional anesthesia such as patients refusing LA, clotting abnormalities, impaired mental status, or allergy to any of the study medications. Furthermore, patients were excluded if they had the severe cardiac disease, chronic obstructive lung disease, and a history of sleep apnea.

These patients were randomly allocated using a computer-generated list into three equal groups all received 10 ml of local peribulbar anesthesia and IV infusion of drugs as follows:

- Group I (control group): Received mixture of bupivacaine 0.5% (4.5 ml) + lidocaine 2% (4.5 ml) + normal saline (1 ml) +150 IU hyaluronidase + IV infusion of normal saline.
- Group II: Received mixture of bupivacaine 0.5% (4.5 ml) + lidocaine 2% (4.5 ml) + dexmedetomidine 50 μg (1 ml) + 150 IU hyaluronidase + IV infusion of normal saline.
- Group III: Received mixture of bupivacaine 0.5% (4.5 ml) + lidocaine 2% (4.5 ml) + normal saline (1 ml) + 150 IU hyaluronidase + IV dexmedetomidine 1 μg/kg over 10 min; followed by 0.4 μg/kg/h IV infusion.

All infusions were started just before peribulbar injection and stopped at the end of surgery.

At the preoperative visit, the anesthetic technique and study protocol were explained to the patients in details. The patients fasted for 8 h and were un-premedicated to the operating room. A peripheral IV line inserted and standard monitoring including noninvasive blood pressure (BP), five leads electrocardiography, heart rate (HR), and oxygen saturation applied. Supplemental O_2 at 2 L/min via nasal cannula was used throughout the procedure.

26-G, 13 mm a short beveled needle 26-G, 13-mm inserted through the conjunctiva in the inferotemporal quadrant as far laterally as possible. The needle directed perpendicularly parallel to the orbital floor for the whole length of the needle then 5 ml of study drug mixture injected slowly after negative aspiration to avoid intravascular injection. The remaining 5 ml of the drug injected at 2 mm medial and inferior to the supraorbital notch. Then ocular massage applied gently to the eyeball.

The following measures were assessed:

1. Onset of block: Time started from injection of LAs till complete paralysis of lids and globe.
2. Duration of block which was the time started from complete block till eyes move freely.
3. Sedation level: By Ramsay Sedation Scale at every 10 min during surgery and every 30 min during first 2 h [Table 1][11]
4. Intra-ocular pressure (IOP): Before injection of LA (baseline) and after a complete akinesia of the globe before surgical incision.
5. Patients' hemodynamics: HR and mean arterial blood pressure (MAP) recorded every 5 min. During the surgery

and in the immediate postoperative period (at 15 and 30 min).

6. Adverse effects including all of the following:
   - Bradycardia (HR <50 beats/min).
   - Hypotension (MAP <50 mmHg sustained for more than 10 min).
   - Respiratory rate (RR) depression (RR <10/min).
   - Oxygen desaturation ($SpaO_2$ <92%) recorded.

Statistical analysis

Data analysis was done using SPSS version 21(Armonk, NY: IBM Corp). Quantitative data presented as mean and standard deviation and were analyzed by one-way ANOVA test. MAP and HR data were analyzed by repeated measure ANOVA test. Qualitative data presented as numbers and percentage and were analyzed using Chi-square test.

Results

Demographic characteristics and time of the procedure showed the nonsignificant difference among groups [Table 2].

There was a significant decrease in the onset of the block in Group II in comparison with both other groups. *Post-hoc* analysis revealed no difference between Groups I and III [Table 3a and b].

Duration of the block in Group II patients showed a significant increase in the length of the block followed by Group III in comparison with Group I [Table 4a and b].

Mean Ramsay Sedation Score in Group III showed a significant increase in comparison with the two other groups while there was no significant difference between Group I and Group II [Figure 1].

There was a significant decrease in IOP in Group II and Group III 10 min after injection. *Post-hoc* analysis revealed that Group III showed a significant decrease in comparison with Groups I and II. It also revealed that Group II showed a highly significant decrease in comparison with Group I ($P < 0.005$) [Table 5a and b].

Heart rate showed a significant decrease in Group III as compared to the other two groups ($P < 0.05$) during the time of dexmedetomidine infusion. MAP showed a nonsignificant difference among groups [Figures 2 and 3].

Regarding complications, only two patients in Group III developed bradycardia treated by atropine 0.01 mg/kg.

Table 1: Ramsay Sedation Scale

Score	Response
1	Anxious or restless or both
2	Cooperative, orientated and tranquil
3	Responding to commands
4	Brisk response to a stimulus
5	Sluggish response to a stimulus
6	No response to a stimulus

Table 2: Demographic characteristics

Characteristic	Group I	Group II	Group III	Test of significance	*P*
Age (years)	54.3±7.4	53.7±6.7	52.5±6.7	F=0.52	0.59
Sex					
Male	18	16	20	χ^2=1.1	0.57
Female	12	14	10		
Weight (kg)	79.6±10.3	78.03±9.2	80.6±10.8	F=0.49	0.61
Height (cm)	170.6±7.8	172.5±7.6	171.8±7.67	F=0.48	0.6
ASA					
I	11	13	10	χ^2=0.66	0.72
II	19	17	20		
Time of surgery (min)	27.3±8.02	25.7±6.96	28.2±7.6	F=0.8	0.4

ASA: American society of anesthesiologists

Table 3a: Onset of block

Onset of block	Group I	Group II	Group III	F-test	*P*
Onset of block (min)	6.6±1.54	5.7±1.68	6.3±0.84	F=3.6	0.03

Table 3b: Onset of block

Group	*t*-test	*P*
Group I		
Group II	2.3	0.024
Group III	1.04	0.3
Group II		
Group III	1.84	0.07

Table 4a: Duration of block

Duration of block	Group I	Group II	Group III	F-test	*P*
Duration of block (min)	180.1±22.6	282.4±39	213.1±41.2	F=65.7	<0.001

Table 4b: Duration of block

Group	*t*-test	*P*
Group I		
Group II	12.4	<0.001
Group III	3.8	<0.001
Group II		
Group III	6.68	<0.001

Discussion

Dexmedetomidine is a selective alpha two adrenoreceptor agonist. It provides dose-dependent sedation and

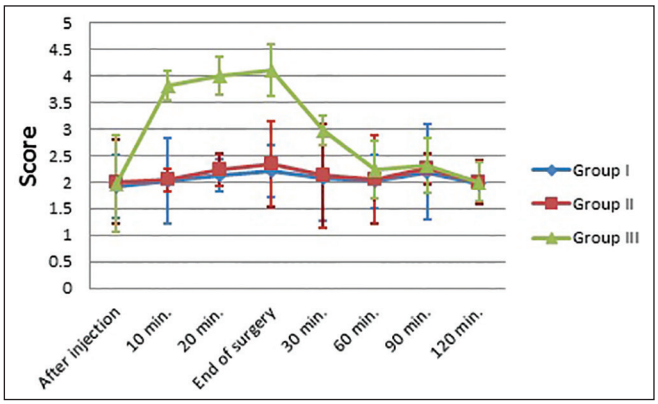

Figure 1: Ramsay sedation score

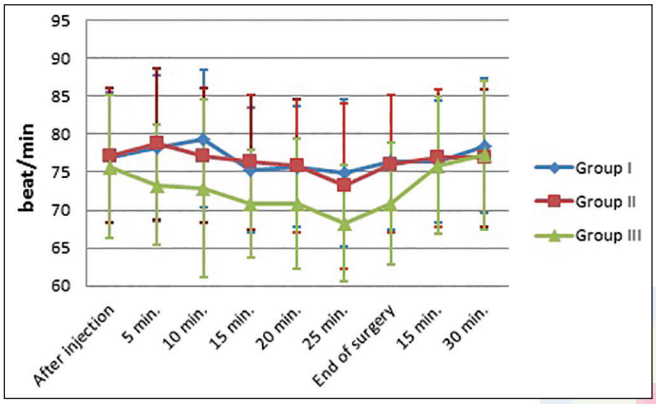

Figure 2: Comparison among groups regarding heart rate

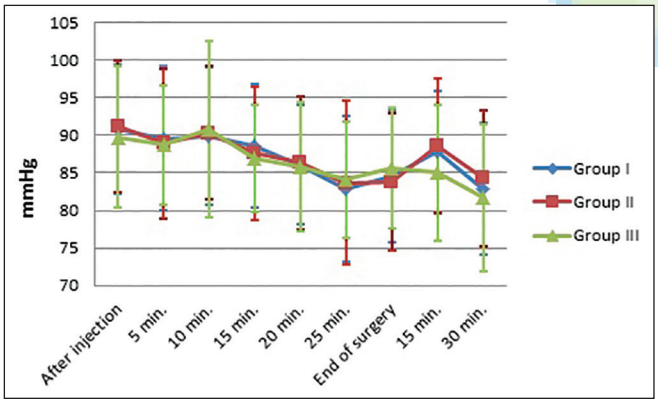

Figure 3: Comparison among groups regarding mean arterial blood pressure

analgesia without relevant respiratory depression, now dexmedetomidine is used as adjuvant to LA drugs in peripheral nerve block and eye block.

In this study, we noticed that there was a significant decrease in the onset of block when use dexmedetomidine as adjuvant to LA in patients undergoing cataract surgery with peribulbar block (Group II) 5.7 ± 1.68 min in comparison to when use LA alone (Group I) 6.6 ± 1.54 min or when use dexmedetomidine as IV sedation with peribulbar block (Group III) 6.3 ± 0.84 min

Table 5a: Comparison among groups regarding intra-ocular pressure (mmHg)

Intra-ocular pressure	Group I	Group II	Group III	F-test	*P*
Baseline	15.5±1.7	14.9±2.02	15.3±1.8	0.84	0.4
After injection	15.7±1.5	14.4±1.8	12.6±2.4	18.4	<0.01**

**Statistically significant

Table 5b: Comparison among groups regarding intra-ocular pressure (mmHg)

Intra-ocular pressure	*t*-test	*P*
Group I		
Group II	2.9	0.005
Group III	5.8	<0.001
Group II		
Group III	3.2	0.002

$P = 0.03$. On the other hand, duration of the block showed a significant increase in the length of the block in Group II 282.4 ± 39 min followed by Group III 213.1 ± 41.2 min in comparison with Group I 180.1 ± 22.6 min $P < 0.001$. About adequate level of sedation, mean Ramsay sedation score in Group III showed a significant increase in comparison with the two other groups while there was no significant difference between Group I and Group II. Furthermore, there was a significant decrease in IOP in Group II 14.4 ± 1.8 mmHg and Group III 12.6 ± 2.4 mmHg 10 min after injection in comparison to group I 15.7 ± 1.5 mmHg, *post-hoc* analysis revealed that Group III showed a significant decrease in comparison with Groups I and II. It also revealed that Group II showed a highly significant decrease in comparison with Group I ($P < 0.005$). Finally, HR showed a significant decrease in Group III as compared to the other two groups ($P < 0.05$). But MAP showed a nonsignificant difference among groups.

The effect of dexmedetomidine as an adjuvant to LA in patients undergoing cataract surgery with peribulbar block in the present study accepted by Channabasappa *et al.*[12] reported that a combination of bupivacaine and lidocaine with dexmedetomidine in peribulbar anesthesia provides the sedation that enables full cooperation. This mixture also helps to decrease the IOP significantly, shorten sensory and motor block onset time and extend motor and sensory block durations.

And this goes in line with the current study carried out by Memis *et al.*[13] who concluded that the addition of 0.5 μg/kg dexmedetomidine to lidocaine 1% for IV regional anesthesia (IVRA) improves quality of anesthesia and perioperative analgesia without causing side effects. Furthermore, Kol *et al.*,[14] found that the addition of dexmedetomidine to prilocaine in IVRA led to shortened sensory block onset

time and prolonged sensory block recovery time without causing adverse effects. Esmaoglu *et al*.[15] reported that dexmedetomidine as an adjuvant to levo-bupivacaine for axillary brachial plexus block markedly prolongs the duration of the block and shortens the onset time in addition to prolongation of postoperative analgesia.

In the present study, IV administration of dexmedetomidine during peribulbar block, prolongs the duration of block, decreases the IOP and provides a satisfactory level of intra-operative sedation with hemodynamic stability. Although akinesia and analgesia can be achieved with a regional block, appropriate sedation may lower the IOP and pain on injection, prevent the hypertensive response to anxiety and LA injection, and provide patient comfort. The mechanism of action of dexmedetomidine is activation of the receptors in the brain, and spinal cord inhibits neuronal firing by presynaptic activation of the α_2 adrenoceptor inhibits the release of norepinephrine, terminating the propagation of pain signals. Postsynaptic activation of α_2 adrenoceptors in the central nervous system inhibits the sympathetic activity and thus can decrease BP and HR. Combined, these effects can produce analgesia, sedation; also the responses to activation of the receptors include contraction of vascular and other smooth muscle and decreased IOP.

Abdalla *et al*.[16] who studied the effects of IV infusions of a small dose of dexmedetomidine during ophthalmic surgery under LA (0.5 μg/kg.) for 10 min followed by (0.2 μg/kg/h) for 50 min. They noticed that the dexmedetomidine in that dose has an adequate control of HR, BP and decreases IOP in addition to a sedative effect.

Rutkowska *et al*.[17] examined the effect of parenteral dexmedetomidine on patients with the end-stage renal disease during brachial plexus block and concluded that it can prolong the duration of brachial plexus block.

The previous studies[12-17] provide an evidence that dexmedetomidine through either parenteral or systemic route can augment the regional blocks. Our study represents another aspect for the augmentation of the regional blocks but this time in the ophthalmic regional block.

Conclusion

Dexmedetomidine is a useful drug as an additive to bupivacaine in peribulbar anesthesia, as it shortens onset time, prolong block durations, significantly decreases the IOP with minimal side effects. On the other hand, IV administration of dexmedetomidine during peribulbar block, extending the time of block, reduces the IOP and provides a satisfactory level of intra-operative sedation with hemodynamic stability.

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Conflicts of interest

There are no conflicts of interest.

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