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A comparison of retrobulbar block, sub-Tenon block, and topical anesthesia during cataract surgery

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PURPOSE. *This randomized, double-blinded, prospective study was performed to compare the intraoperative hemodynamic variables and the patient-reported outcomes, such as intra- and postoperative analgesia and patient satisfaction, of retrobulbar block, sub-Tenon block, and topical anesthesia during cataract surgery under monitored anesthesia care.*
METHODS. *Eighty-one patients, ASA physical status I–III, undergoing elective cataract surgery under monitored anesthesia care, aged between 43 and 78 years, were randomly assigned to three groups: retrobulbar block (group R), sub-Tenon block (group S), or topical anesthesia (group T). Three minutes after the start of monitored anesthesia care with lidocaine-propofol-remifentanil mixture, an ophthalmologist performed regional anesthesia. Intraoperative hemodynamics, pain score, and patients' satisfaction with the anesthetic experiences were recorded by a study-blinded anesthesiologist.*
RESULTS. *Mean arterial pressure and heart rate in group R were significantly higher than those in groups S and T during and just after the regional block ($p<0.05$). Group R required smaller dosage of patient controlled sedation and fewer supplemental bolus doses than groups S and T ($p<0.05$). On the other hand, group S showed the highest satisfaction scores among the three groups ($p<0.05$).*
CONCLUSIONS. *Sub-Tenon block seems to be better than retrobulbar block and topical anesthesia in patient satisfaction though adequate analgesia was achieved after retrobulbar block during cataract surgery under monitored anesthesia care. (Eur J Ophthalmol 2009; 19: 240-6)*

KEY WORDS. *Analgesia, Cataract surgery, Retrobulbar block, Patient satisfaction, Sub-Tenon block, Topical anesthesia*

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INTRODUCTION

Cataract surgery is one of the most common outpatient procedures and can be safely performed with a regional nerve block. However, regional nerve block administration may deliver a painful stimulus that is sufficient to cause adverse hemodynamic changes (1). In addition, cataract surgery patients have an average age of 70–75 years and frequently have concurrent medical problems, such as hypertension or diabetes mellitus (2). Therefore, monitored anesthesia care (MAC) with proper sedatives and analgesics under the supervision of an anesthesiologist seems justified in patients who underwent cataract surgery (1, 3).
Local anesthetic is injected into the muscle cone during retrobulbar block or around the globe during sub-Tenon block (4), and topical anesthesia is performed by instilling local anesthetics in the forms of eyedrops or gel into

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the conjunctival sac (4). Several studies have compared regional blocks, i.e., sub-Tenon block vs topical anesthesia or retrobulbar block vs topical anesthesia, performed with or without MAC during cataract surgery with respect to analgesia and patient satisfaction (5-10). However, no comparative investigation has been conducted on the comprehensive effects of these three blocks on the intraoperative hemodynamic variables, analgesia, and patient satisfaction in patients undergoing cataract surgery under MAC. This randomized, double-blind clinical study was performed to investigate which regional technique provided better analgesia and patient satisfaction combined with patient controlled sedation among retrobulbar block, sub-Tenon block, and topical anesthesia.

METHODS

This study was approved by the institutional review board of Seoul National University Hospital and written informed consent was obtained from all participants. A total of 81 adult patients, ASA physical status I–III, aged between 43 and 78 years, undergoing elective cataract surgery under MAC, from April to October 2007, were included in this prospective study. Those who refused to participate in the investigation, chronically used opioids or analgesics, had an allergy to any of the study medications, and those with end stage renal diseases on dialysis were excluded. An anesthesiologist explained to all patients the use of a patient-controlled sedation (PCS) device in the preanesthetic visit.

No premedication was prescribed in any patient. Monitoring included electrocardiography (Lead II), noninvasive blood pressure, and peripheral oxygen saturation. A nasal prong and the end-tidal CO_2 sampling tubing were positioned to deliver 5 L/min oxygen and to monitor respiration. Verbal contact was maintained during surgery.

The MAC anesthetic mixture (total volume 20 mL) consisted of 2% lidocaine (LDC) 4 mL (4 mg mL^{-1}), 1% propofol (PPF) 12 mL (6 mg mL^{-1}), and remifentanil 4 mL (5 μg mL^{-1}), which was modified from the previous investigation (11). This mixture was prepared in a pharmacy and delivered to the anesthesiologist using a PCS device (AM3300, Acemedical Co., Korea). The device was set at a basal rate 15 mL hr^{-1}, at a bolus dose 1 mL, with a 3 min lockout. Patients were told to press the bolus administration button if insufficient analgesia was suspected.

Three minutes after connecting a PCS device, the ophthalmologist performed regional anesthesia. Patients were randomly allocated into three groups according to a computer-generated list of random numbers which were placed in opaque sealed envelopes; Group R (n=27) received a retrobulbar block, Group S (n=27) a sub-Tenon block, and Group T (n=27) topical anesthesia. Retrobulbar block was performed with a 25-gauge, 31-mm long needle inserted through the conjunctiva. Four mL of local anesthetic agent (2% lidocaine, and 0.5 mL of hyaluronidase, 3.75 IU/mL) is injected into the retrobulbar space. During sub-Tenon block, 4 mL lidocaine 2% containing 30 units per mL of hyaluronidase was injected in the inferomedial quadrant of the eye, using a 19-gauge sub-Tenon cannula (Visitech Sarasota, FL). Topical anesthesia consisted of 5 doses (approximately 40 μL per dose) of lidocaine gel (lidocaine hydrochloride 2%, AstraZeneca, Sweden). Regional anesthesia was performed by the same surgeon using the same technique. An anesthesiologist and the data collector (nursing staff) were all blinded to patient group assignment. Temporal clear cornea incisions and phacoemulsification were performed and foldable silicone intraocular lens (IOL) was placed in all cases.

Heart rate (HR), mean arterial pressure (MAP), respiratory rate, oxygen saturation (SpO_2), and end-tidal CO_2 were recorded during the surgery. All adverse events including bradycardia (HR <60 beats min^{-1}), tachycardia (HR >100 beats min^{-1}), hypotension (MAP <60 sustained for >10 min), hypertension (>20% above the baseline), respiratory depression (respiratory rate <10 breaths min^{-1}), oxygen desaturation (SpO_2 < 90%), or unplanned hospital admission were recorded. The occurrence of any surgical complication or incident (if any) was also recorded. Intraoperative sedation scores were evaluated using a four-point scale (1: alert; 2: awake but drowsy; 3: asleep but arousable; and 4: unarousable).

After the operation, patients were transferred to a recovery room and were evaluated for recovery every 5 minutes using the Modified Aldrete scoring system (11) until ready for discharge from the recovery room. The criterion for patient discharge was the achievement of a Modified Aldrete score of 10. Time to discharge from the recovery room and postoperative adverse effects, including postoperative nausea and vomiting (PONV), were recorded. To minimize the effects of sedation on

patients' judgment, they were asked to assess their levels of perioperative pain and the quality of their overall anesthetic experiences at discharge. Numerical rating scale (NRS) of 100 was used for these visually handicapped persons and intravenous bolus doses of analgesics (ketorolac 30 mg) were administered, if the postoperative pain (NRS) was above 40. The Iowa Satisfaction with Anesthesia Scale (13), a self-administered written questionnaire, was used to evaluate satisfaction scores and overall anesthetic experiences.

A sample size of 27 patients per group was calculated using the preliminary result of 30 patients (10 patients of each group). The primary endpoint of this study was to evaluate patient satisfaction scores. The means of the groups are 55 (Group S), 50 (Group T), and 46 (Group R) and the standard deviation within the group is about 9. The total sample of 81 patients (27 patients per group) was required by power analysis (power of 90% and type I error of 5%) using sample size software (PASS 2005®, NCSS, USA). The secondary endpoints were pain scores, intraoperative hemodynamics (HR and MAP), and the recovery profiles. Data (patient characteristics, operation time, anesthesia time, dosage of PCS, recovery room stay, and Modified Aldrete score) were analyzed using analysis of variance (ANOVA), followed by Bonferroni correction. Fisher exact test was performed for ASA class, preexisting disease, pain scores, and satisfaction scores. Repeated measures ANOVA was used to compare the data over time (mean blood pressure and heart rate). If there is a statistical difference ($p<0.05$) between the groups in the repeated measures ANOVA, one way ANOVA with post hoc Bonferroni was used to compare the data at each time point. Chi square was used for comparison of incidence variables (preexisting disease, ASA class, gender, intraoperative sedation score, intra- and postoperative adverse events, and postoperative analgesics). Values are expressed as counts, percentages, or means ± SD. p Values of <0.05 were considered statistically significant.

RESULTS

Patient characteristics and operation and anesthesia times are described in Table I. The groups were similar with regard to age, weight, height, gender, ASA physical status, operation time, and anesthesia time.

There are statistical differences between the groups for the time effect in heart rate ($p=0.016$) and MAP ($p=0.032$). Immediately after regional anesthesia, heart rate and mean blood pressure in Group R were significantly higher than those in Groups S and T ($p<0.05$) (Fig. 1).

Patients in Group R had the highest pain scores during regional block ($p<0.05$). However, intraoperative and postoperative pain scores in Group T were higher than in Groups S and R ($p<0.05$) (Tab. II). Group R required a smaller total amount of PCS and fewer supplementary bolus doses during operation than Groups S or T ($p<0.05$) (Tab. II).

TABLE I - PATIENT CHARACTERISTICS AND ANESTHETIC VARIABLES

	Group S (n=27)	Group T (n=27)	Group R (n=27)
Age (yr)	63.8±6.9	65.6±7.9	65.5±7.9
Weight (kg)	57.5±8.1	61.9±9.7	59.9±7.4
Height (cm)	156.9±7.7	159.5±9.7	159.2±9.5
Gender (M/F)	11/16	11/16	11/16
Operation time (min)	22.1±4.4	21.1±3.7	22.4±3.1
Anesthesia time (min)	38.7±5.2	36.0±5.5	38.9±5.9
ASA class I/II/III	7/18/2	6/20/1	7/18/2
Preexisting disease			
Hypertension	16	14	15
Diabetes mellitus	8	7	6
Ischaemic heart disease	2	2	1

There were no statistically significant differences among the groups in age, weight, height, gender, ASA physical status, operation time, or anesthesia time. Values are expressed as mean ± SD or number of patients.
Group S = sub-Tenon block group; Group T = topical anesthesia group; Group R = retrobulbar block group.

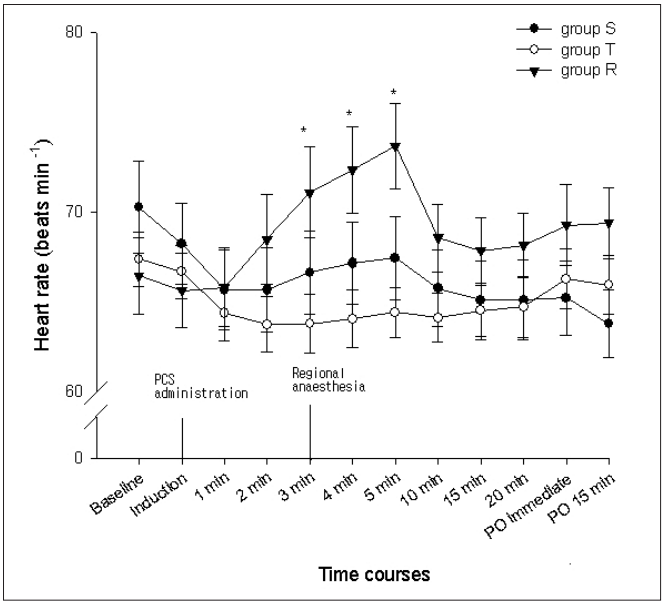

Fig. 1 - *Changes in mean arterial pressure and heart rate during the study period. Values are mean ± SE. Mean blood pressure and heart rate in Group R were significantly higher than those in Groups S and T right after regional anesthesia (p<0.05). Group S: sub-Tenon block group; Group T: topical anesthesia group; Group R: retrobulbar block group. *p<0.05 Compared with Group S and Group T.*

Bradycardia was recorded in 3, 2, and 1 patients in Groups S, T, and R, respectively. Tachycardia occurred in 2 patients in Group S and in 15 patients in Group R. Three patients in Group S, 3 in Group T, and 12 in Group R had hypertension during surgery. Respiratory depression or oxygen desaturation was not observed in any group (Tab. II).

Patients in group S had the highest anesthetic experience satisfaction scores (Tab. III). Modified Aldrete scores and recovery room stays were similar in the three groups. Postoperative analgesics were needed in 2, 8, and 1 patients in the S, T, and R groups, respectively (Tab. III).

No surgical complications or postoperative adverse events, including PONV, were reported by any patient.

DISCUSSION

In this prospective, randomized, double-blind study, we compared the effects of sub-Tenon block, topical anesthesia, and retrobulbar block on hemodynamic variables, pain intensity, and satisfaction in patients who

TABLE II - ANESTHETIC REQUIREMENTS, PAIN SCORES, SATISFACTION SCORES, AND INTRAOPERATIVE ADVERSE EFFECTS

	Group S (n=27)	Group T (n=27)	Group R (n=27)
Total volume of PCS mixture (mL kg^{-1} hr^{-1})	0.25±0.08	0.27±0.06	0.22±0.03*
Bolus dosage (mL hr^{-1})	1.7±0.7	3.2±0.9	1.2±0.4*
Intraoperative sedation score‡			
1	18	19	17
2	8	5	8
3	1	3	2
4	0	0	0
Pain score (100-mmVAS)			
At regional block	12.9±7.9	5.6±3.5	54.7±12.2*
During operation	11.5±8.8	31.7±18.3†	3.14±5.0
After operation	21.1±18.3	29.1±18.3†	3.7±5.5
Adverse effects			
Bradycardia§	2	1	1
Tachycardia//	2	0	15*
Hypotension¶	1	0	1
Hypertension#	3	3	12*
Respiratory depression**	0	0	0
Oxygen desaturation††	0	0	0

Values are expressed as mean ± SD or number of patients. *p<0.05 Compared with Group S and Group T; †p<0.05 Compared with Group S and Group R; ‡Sedation scores: 1: alert; 2: awake but drowsy; 3: asleep but arousable; 4: unarousable; §Bradycardia: heart rate <60 beats min–1. //Tachycardia: heart rate >100 beats min–1; ¶Hypotension: mean blood pressure <60 sustained for >10 min; #Hypertension: mean blood pressure >20% above the baseline; **Respiratory depression: respiratory rate <10 breath min–1; ††Oxygen desaturation: oxygen saturation <90%.
Group S = sub-Tenon block group; Group T = topical anesthesia group; Group R = retrobulbar block group; PCS = patient-controlled sedation; VAS = visual analogue scale.

TABLE III - RECOVERY PROFILES, SATISFACTION SCORES, AND POSTOPERATIVE ADVERSE EVENTS

	Group S (n=27)	Group T (n=27)	Group R (n=27)
Modified Aldrete score	9.9±0.2	9.9±0.3	9.9±0.2
Recovery room stay (min)	5.4±1.9	5.7±1.4	5.2±0.9
Postoperative analgesics	2	8*	1
ISAS	57±3†	51±5	48±4
Postoperative adverse events			
PONV	0	0	0
Unplanned hospital admission	0	0	0

Values are expressed as mean (SD) or number of patients; *p<0.05 Compared with Group S and Group R; †p<0.05 Compared with Group T and Group R; Group S = sub-Tenon block group; Group T = topical anesthesia group; Group R = retrobulbar block group; ISAS = the Iowa Satisfaction with anesthesia scale; PONV = postoperative nausea and vomiting.

underwent cataract surgery with MAC. This study shows that the highest satisfaction scores were awarded by patients who had a sub-Tenon block although retrobulbar block required a smaller total dosage of PCS and fewer supplemental bolus doses than sub-Tenon block or topical anesthesia during cataract surgery.

Cataract surgery is the commonest outpatient ophthalmic procedure. Regional anesthesia under MAC is usually preferred as most patients have old age and cardiopulmonary diseases (2). During MAC, an anesthesiologist monitors a patient undergoing diagnostic or therapeutic procedures and administers sedative-analgesic drugs to minimize patient anxiety, discomfort, and pain (14). The mixture of lidocaine, propofol, and remifentanil was used with PCS device to provide sedation and analgesia and this regimen was based on and modified from the previous investigation (11). Propofol has fast onset, easy titration, and fast offset (15). Remifentanil is an ultra-short acting opioid which has rapid onset (1–2 min) with extremely short duration of action (context-sensitive half-life of 3–8 min) (16). These properties make propofol and remifentanil attractive agents for MAC during cataract surgery as the anesthetic drug should allow the patient to be awake for cooperation while providing adequate analgesia and sedation and no residual sedation should remain for early discharge of day surgery (17).

Several regional anesthetic methods have been used for cataract surgery and many studies have been performed (5-10) that reflect a preference for anesthetic techniques. However, these reported results on the relative effectiveness of blocks during cataract surgery are controversial. Jacobi et al (5) showed that topical anesthesia provided adequate analgesia and comfortable conditions for patients as compared with a retrobulbar block. On the other hand, the pain intensities of topical anesthesia and retrobulbar block were not found to be statistically different in clinical trials (6-8). Furthermore, studies (9, 10) that investigated patient discomfort and preference for topical anesthesia and a sub-Tenon block concluded that sub-Tenon block was more comfortable for patients and was awarded higher satisfaction scores during cataract surgery.

In the present study, the majority of patients experienced severe pain due to needle insertion during retrobulbar block administration, but adequate analgesia was achieved subsequently. Moreover, patients who received a retrobulbar block required less anesthetic than patients in the other two groups. Highest MAP and heart rate in patients who received a retrobulbar block may be related to an endocrine response triggered by severe pain during regional anesthesia. On the other hand, patients who received topical anesthesia had more perioperative pain and required more analgesics during the postoperative period than patients in the other two groups. Several investigations have reported more pain during cataract surgery under topical anesthesia (10, 18, 19) and accordingly, sedation and analgesia provided by anesthesiologist through monitored anesthesia care may be needed. In this study, propofol and short-acting opioids (remifentanil) were administered using PCS during operation to alleviate peri-procedural stress and pain.

Patients who received a sub-Tenon block had higher anesthetic experience satisfaction scores than patients

in the other two groups. The Iowa Satisfaction with Anesthesia Scale consists of an 11-item questionnaire, and total scores are used to measure patient satisfaction in those who have undergone cataract surgery with MAC (13). Pain during and after cataract surgery has been identified to be a major reason for poor satisfaction after cataract surgery (20). A sub-Tenon block is performed by injecting local anesthetic under the Tenon capsule with a blunt cannula, which reduces pain during the procedure and consequently increases the satisfaction rate.

Most of the patients in this study cooperated adequately during surgery with the intraoperative sedation scores less than 2 (Tab. II). No complications associated with regional anesthesia and surgery occurred. Moreover, no PONV in relation to remifentanil was noted, which may have been related to the antiemetic effect of the coadministered propofol (21).

Peribulbar block has also been used in cataract surgery. Local anesthetic is injected into the muscle cone during retrobulbar block (4) and into the extraconal space during peribulbar block (22). Peribulbar block has not been included in this comparison as peribulbar and retrobulbar block are the common needle techniques and were considered to have similar effects during cataract surgery.

In conclusion, the present study indicates that patients who underwent a sub-Tenon block showed the highest anesthetic experience satisfaction scores, whereas patients who received a retrobulbar block had the lowest pain scores and anesthetic requirements during cataract surgery under monitored anesthesia care. The reasons for the low patient satisfaction encountered during this study were inadequate perioperative analgesia for topical anesthesia and the pain caused by needle insertion for the retrobulbar block. These results may support the current practice of combined local anesthesia (topical anesthesia with sub-Tenon block vs topical anesthesia with retrobulbar block) as topical anesthesia alone is inadequate for perioperative pain but may reduce the pain during the administration of regional block.

Proprietary interest: None.

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