Posterior vitrectomy under topical anesthesia

Halil Bahçecioglu,*† MD; Mustafa Ünal,‡ MD; Özgür Artunay,† MD; Rifat Rasier,† MD; Ahmet Sarici,* MD

ABSTRACT • RÉSUMÉ

Background: To determine the safety and efficacy of topical anesthesia in posterior vitrectomy.

Methods: A total of 93 patients (93 eyes) with various vitreoretinal diseases not needing scleral buckling and with short predicted duration of surgery underwent posterior vitrectomy under topical (49 eyes) or retrobulbar (44 eyes) anesthesia. Patients in the topical group were sedated with neuroleptic anesthesia. Postoperatively, patients were shown a visual analogue pain scale (VAPS) from 0 (no pain) to 10 (unbearable pain) to rate the levels of pain. The main outcome measures were overall and worst intraoperative pain scores, duration of surgery, and pain score during the administration of the retrobulbar anesthetic agent.

Results: Mean surgical time was 57.9 minutes in the topical group and 56.6 minutes in the retrobulbar group ($p > 0.05$). The pain scores were not significantly different. Mean overall pain scores were 1.71 (SD 1.04, range 0–5) in the topical group and 1.38 (SD 1.04, range 0–3) in the retrobulbar group ($p > 0.05$). Mean worst pain scores were 3.20 (SD 1.30, range 1–7) and 2.95 (SD 0.73, range 1–4), respectively ($p > 0.05$). There was no significant correlation between duration of surgery and overall pain score in either group ($r = 0.146$, $p = 0.356$, and $r = 0.174$, $p = 0.385$, respectively). No patient required additional injection anesthesia in the topical group.

Interpretation: Topical anesthesia combined with systemic sedation and analgesia in posterior vitrectomy procedures provided sufficient analgesic effects in selected patients needing no scleral buckling and with short predicted surgery time.

Contexte : Établir la sécurité et l'efficacité de l'anesthésie topique pour la vitrectomie postérieure.

Méthodes : L'étude a porté sur 93 yeux de 93 patients qui, atteints de diverses maladies vitréorétiniennes, ont subi une vitrectomie postérieure ne nécessitant pas de plissement scléral. On avait prévu que les chirurgies prendraient peu de temps. Pour 49 yeux, l'anesthésie a été topique et la sédation, obtenue par anesthésie neuroleptique; pour 44 yeux, l'anesthésie a été rétrobulbaire. Après l'opération, les patients ont utilisé une échelle de douleur analogue visuelle (EDAV) pour évaluer la douleur de 0 (sans douleur) à 10 (douleur insupportable). Les principaux résultats ont porté sur l'ensemble et les pires degrés de douleur intraopératoire, la durée de l'opération et le degré de douleur pendant l'administration de l'agent anesthésique rétrobulbaire.

Résultats : La durée moyenne de la chirurgie a été de 57,9 minutes pour le groupe d'anesthésie topique et de 56,6 minutes pour celui d'anesthésie rétrobulaire ($p > 0,05$). Dans l'ensemble, le degré moyen de douleur a été de 1,71 (ÉT 1,04, fourchette 0–5) et de 1,38 (ÉT 1.04, fourchette 0–3), respectivement ($p > 0,05$). Le degré moyen de douleur intolérable perçue a été de 3,20 (ÉT 1,30, fourchette 1–7) et de 2,95 (ÉT 0,73, fourchette 1–4), respectivement ($p > 0,05$). Il n'y avait pas de corrélation entre la durée de l'opération et le degré général de douleur dans aucun groupe ($r = 0,146$, $p = 0,356$; et $r = 0,174$, $p = 0,385$ respectivement). Aucun patient n'a eu besoin d'injection additionnelle d'anesthésique dans le groupe d'anesthésie topique.

Interprétation : L'anesthésie topique combinée avec la sédation systémique et l'analgésie pour la vitrectomie postérieure a procuré suffisamment d'effet analgésique chez les patients sélectionnés qui n'avaient pas besoin de plissement scléral lorsque l'opération devait être de courte durée.

From *the Department of Ophthalmology, Istanbul University Faculty of Medicine, Istanbul, Turkey, †the Department of Ophthalmology, Kadir Has University Faculty of Medicine, Istanbul, Turkey, and ‡the Department of Ophthalmology, Akdeniz University Faculty of Medicine, Antalya, Turkey

Correspondence to: Mustafa Ünal, MD, Akdeniz Üniversitesi Tip Fakültesi, Göz Hastaliklari A.D., Antalya, Turkey; fax 90-242-2274490; drmustafaun@hotmail.com

Originally received April 12, 2006. Revised Dec. 5, 2006
Accepted for publication Dec. 12, 2006

This article has been peer-reviewed. Cet article a été évalué par les pairs.

Can J Ophthalmol 2007;42:272–7
doi: 10.3129/can.j.ophthalmol.i07-004

Local anesthesia modalities for vitreoretinal surgery include retrobulbar[1,2] and parabulbar anesthesia,[3] subtenon anesthesia,[4,5] peribulbar anesthesia,[6,7] and even topical anesthesia.[8–13]

Topical anesthesia in ocular surgery has many advantages over other forms of local anesthesia involving needle injection. Although some are rare, many complications have been reported with retrobulbar anesthetic injection, including ptosis and diplopia,[14] globe perforation,[15,16] cranial nerve palsies,[17] seizures and cardiorespiratory arrest,[18,19] restrictive strabismus,[20] retinal vein and artery occlusion,[21,22] and injury to the optic nerve.[23]

Other forms of injection anesthesia can also result in complications: globe perforation during peribulbar injections,[24,25] cardiovascular problems[26] and even globe perforation during subtenon anesthesia.[27]

The advantages of topical anesthesia are quick visual recovery, easier and more cost-effective administration, and avoidance of needle-related complications associated with the injection of local anesthesia. Topical anesthesia has been widely used for phacoemulsification cataract surgery[28–31] and has proven effective for trabeculectomy,[32,33] for selected cases of pterygium,[34] and for strabismus,[35] corneal trauma,[36,37] and penetrating keratoplasty.[38–40]

Neuroleptic anesthesia has been used as an adjunct to local anesthesia during ophthalmologic procedures, but high doses of sedatives and analgesia may cause life-threatening cardiorespiratory complications.

Although Yepez et al have shown that topical anesthesia combined with neuroleptic anesthesia was also a safe and effective alternative to peribulbar or retrobulbar anesthesia in posterior vitrectomy procedures,[10–12] it has been the subject of some controversy. We initiated this prospective study to determine the safety and efficacy of topical anesthesia in posterior vitrectomy.

Methods

This comparative case series study comprised 93 patients (93 eyes) scheduled for 3-port pars plana posterior vitrectomy using topical (49 eyes) or retrobulbar (44 eyes) anesthesia between January 2003 and August 2005 at the Departments of Ophthalmology at Istanbul University Cerrahpasa Medical Faculty and Kadir Has University Medical Faculty.

The research followed the tenets of the Declaration of Helsinki. All patients signed informed consent forms after they had received an explanation of the nature and possible consequences of the procedure and had been given thorough preoperative counselling on what they would experience during surgery under topical anesthesia, especially possible awareness of some pain sensation in the eye.

The indications for vitrectomy are shown in Table 1. Exclusion criteria were nystagmus, muscle spasm around the eye, speech disorder, age younger than 21 years, claustrophobia, orthopnea, extreme anxiety, mental retardation, previous vitreoretinal surgery, deafness, severe cardiovascular or respiratory disease, active ocular infection, and known allergy to proparacaine. Cases needing scleral buckling and those with a predicted duration of surgery longer than 2 h were also excluded.

Before surgery, the pupils were dilated with 1% tropicamide, 2.5% phenylephrine hydrochloride, and 1% cyclopentolate. Topical anesthesia comprised 0.5% proparacaine hydrochloride drops administered into the conjunctival sac 4 times in the 15 minutes preceding surgery. Additional drops were administered at the beginning of the surgery and during sclerotomy, external bipolar cautery, and conjunctival closure, as well as when the patient felt considerable pain. Premedication comprised 5 to 10 mg diazepam administered orally. Patients in the topical group were given intravenous (IV) midazolam hydrochloride (0.3–3.0 mg) and fentanyl citrate (20–100 μg) at a dose determined by the anesthesiologist, and additional IV sedation medication was used when necessary.

The retrobulbar group received approximately 4 to 6 mL of 0.5% bupivacaine and 2% prilocaine (1:1) in the retrobulbar space via a 27-gauge, 32-mm (1.25 inch) Atkinson needle.

In the operating theatre, all patients received continuous oxygen at 4 L/min through nasal prongs, and the anesthesiologist monitored all standard vital signs. An eyelid speculum was inserted, and then anesthetic status was ascertained by grasping the bulbar conjunctiva and lateral rectus muscle insertion with toothed forceps.

Table 1—Patient data and indications for surgery

	Anesthesia	
	Topical *n* = 49	Retrobulbar *n* = 44
Sex, no. (%)		
Male	20 (41)	20 (45)
Female	29 (49)	24 (55)
Age, years		
Mean	59.3	56.4
Range	41–77	43–70
Indications for posterior vitrectomy		
Vitreous hemorrhage	10	8
Proliferative diabetic retinopathy	10	7
Macular hole	9	7
Epiretinal membrane	8	5
Intraocular foreign body	5	5
Rhegmatogenous retinal detachment	4	6
Uveitic opaque membrane formation	3	3
Lens fragments in the vitreous	–	3

Patients were asked to inform the surgeon if they felt unbearable pain during the surgery.

After conjunctival flap peritomies had been performed, three 20-gauge–wide sclerotomies were created 3.0–3.5 mm posterior to the limbus with a microvitreoretinal blade. The infusion line was sutured inferotemporally.

Approximately 1 hour after surgery, each patient was shown a visual analogue pain scale (VAPS) with numeric and descriptive ratings from 0 (no pain) to 10 (unbearable pain) (Table 2). Patients were asked to use this 11-point scale to rate the levels of overall pain and the worst pain perceived during the surgery. Also, the patients in the retrobulbar group were asked to rate their pain levels during the injection of the anesthetic agent. If patients were unable to see the scale or read the accompanying text, the scale was described and a score was obtained orally.

All the surgical procedures were performed by the same surgeon (Dr. Bahçecioglu). Main outcome measures were overall and worst intraoperative pain scores and duration of the surgery.

Student *t* test or χ^2 analysis was used for data comparison between the study groups. As well, the pain scores for the overall procedure were compared with the duration of surgery to examine whether higher overall scores were associated with longer times. The correlation coefficient (r) was calculated to assess this relation. A p value less than 0.05 was considered significant.

Results

Table 1 shows the demographic data of the patients. The groups were not statistically different with respect to age and sex ($p > 0.05$).

In the topical group, the mean total dose of IV midazolam hydrochloride was 2.0 mg and of fentanyl citrate was 48 µg. Only 28 patients needed sedation and analgesia more than once. All patients remained conscious and communicative during the procedure. No patient required additional retrobulbar, peribulbar, or subtenon anesthesia.

For 12 patients (24.4%) in the topical group and 10 (22.7%) in the retrobulbar group, posterior vitrectomy was combined with phacoemulsification and intraocular lens implantation. Argon laser photocoagulation was performed in 18 patients (36.7%) of the topical group and 15 (34.0%) of the retrobulbar group. After vitrectomy, 5000 centistokes silicone oil was used in 4 patients in the topical group and 5 patients in the retrobulbar group, and sulfur hexafluoride gas was used in 8 and 9 patients in the 2 groups, respectively.

Table 2—Visual pain analogue scale

Pain level	Description
0	No pain
1–3	Mild pain
4–6	Moderate pain
7–9	Severe pain
10	Unbearable pain

The pain scores for overall pain ranged from 0 to 5 (mean 1.71, SD 1.04) in the topical group and from 0 to 3 (mean 1.38, SD 1.04) in the retrobulbar group. These means were not statistically different ($p > 0.05$). Only 3 patients, in the topical group (6%), reported the overall pain as moderate (pain scores 4 to 6). Fig. 1 shows the distribution of the overall pain scores in both groups.

The pain scores for the worst pain perceived ranged from 1 to 7 (mean 3.20, SD 1.30) in the topical group and from 1 to 4 (mean 2.95, SD 0.73) in the retrobulbar group; these means were also not statistically different ($p > 0.05$). Fourteen patients (28.5 %) in the topical group and 9 patients (20.5%) in the retrobulbar group reported 4 or more for the worst pain score ($p > 0.05$). Pain perceived during the administration of the retrobulbar anesthetic agent was reported as the worst pain by 36 of the retrobulbar patients (82%). Fig. 2 shows the distribution of the worst pain scores in both groups.

The mean surgical time was 57.9 (range 40–90) minutes in the topical group and 56.6 (range 38–92) minutes in the retrobulbar group. The difference was not statistically significant ($p > 0.05$). In addition, there was no significant correlation between the duration of surgery and the overall pain score in either group ($r = 0.146$, $p = 0.356$ and $r = 0.174$, $p = 0.385$, respectively).

Interpretation

In the present study, we found that the mean pain scores for the overall pain and the worst pain in the

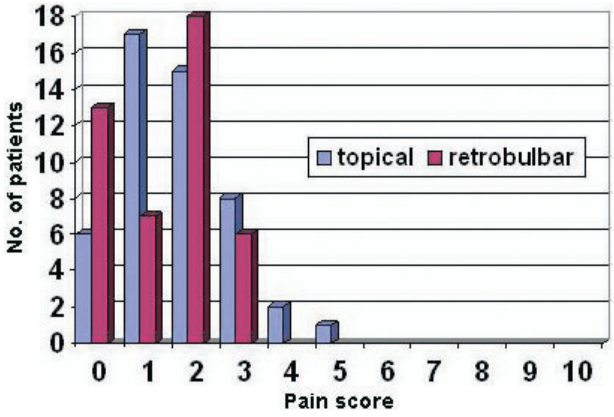

Fig. 1—Distribution of the overall pain scores (11-point scale).

topical anesthesia group were not significantly different from those in the retrobulbar group. In addition, there was no significant correlation between the duration of surgery and the overall pain score in either group.

Patients in the topical group described the worst pain to be of short duration and tolerable. They perceived the highest pain especially during conjunctival opening, the creation of the pars plana sclerotomies, external bipolar cautery, and conjunctival closure. If patients experienced breakthrough pain during any step of the surgery, supplemental topical anesthetic drops or IV sedation and analgesia were administered. These measures helped the topical patients to tolerate the pain easily. None of the patients receiving topical anesthesia reported the surgical procedure as unbearable when asked at the end of the surgery.

Although it was temporary, the worst pain score in the retrobulbar group was found to be as high as in the topical group, mainly because of needle insertion and retrobulbar injection of the anesthetic agent. Of the retrobulbar patients, 82% reported the pain during injection of the anesthetic material as the most painful step of the surgery. They were also afraid and anxious about the pain before the injection. Interestingly, although less discomfort or pain occurs during cataract surgery with retrobulbar anesthesia, patients undergoing simultaneous bilateral cataract surgery have been reported to prefer topical anesthesia, primarily because of the inconvenience or pain of the retrobulbar injection.[41]

A kind of sclerotomy, scleral tunnel incision, has been performed safely in cataract surgery under topical anesthesia. In a study comparing topical and peribulbar anesthesia for scleral tunnel incision, the overall pain scores were not significantly different between the 2 groups, and topical anesthesia for cataract surgery using a scleral tunnel incision has been found to be safe and effective.[42]

Although Yepez et al demonstrated that topical anesthesia could also be safe for a scleral buckling procedure,[11] we excluded the patients who needed scleral buckling, because grasping and traction on the eye muscles and suturing of the sclera would cause unbearable pain and may induce oculocardiac reflex. We also excluded patients whose duration of surgery was estimated to be longer than 2 hours because of possible stress associated with the extended time and increased dosage of the sedatives and analgesics.

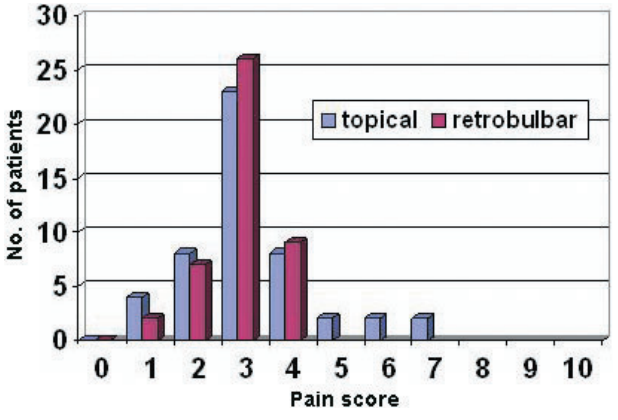

Fig. 2—Distribution of the worst pain scores (11-point scale).

We believe that the most important reason for the comparable levels of pain scores in the 2 groups was definitely the use of neuroleptic anesthesia in the topical group. It should be noted, however, that high doses of sedation and analgesia may cause life-threatening complications. Close monitoring by an experienced anesthesiologist is imperative. Neuroleptic anesthesia should be avoided in patients with respiratory or cardiovascular problems.

Yepez et al used deep sedation with midazolam hydrochloride and fentanyl citrate.[11] In the present study, the mean amount and mean number of administrations of sedatives and narcotics were lower than those reported by Yepez et al. Only 28 patients needed sedation and analgesia more than once. This was possibly due to the shorter surgical time and exclusion of patients needing scleral buckling. In some studies of local anesthesia for vitreoretinal surgery, the dosage of sedation was comparable with that in our study.[2,43]

Recently, a 25-gauge sutureless vitrectomy technique has been gaining popularity among ophthalmology surgeons.[8,44–46] Pain sensation with topical anesthesia during the conjunctival opening, suturing of the sclerotomies, and conjunctival closure may be lessened or prevented by this technique. In the present study, however, none of the patients in the topical group needed injection anesthesia during these steps, and the mean pain score for the worst pain perceived was not significantly higher than the pain score for the retrobulbar injection of the anesthetic agent.

Although topical anesthesia in phacoemulsification allows quick recovery of vision, this advantage is not applicable to our group of patients because of both underlying vitreoretinal disease and injected tamponade materials. Apart from avoiding the complications of injection anesthesia, topical anesthesia has the advantages of easier administration, reduced surgical time and cost, and shortening of the hospitalization period.

The presence of ocular motility during vitrectomy under topical anesthesia may seem a disadvantage because some iatrogenic complications, such as retinal tear or hemorrhage due to intraoperative eye movements, may develop. Intraocular instruments positioned through the pars plana helped the surgeon to steady the

eye and to prevent sudden eye movements. The presence of ocular motility during surgery may even be helpful in that the surgeon can ask the patient to look at the intended side. We had no case of iatrogenic complications due to sudden movement of the eyeball during the procedure.

Endoillumination during the surgery under topical anesthesia may be expected to cause glare and discomfort. None of the patients complained about intraoperative endoillumination.

Patient selection is definitely important for topical anesthesia. The patients were selected carefully and evaluated medically and psychologically as to whether they were appropriate cases for the vitrectomy under topical anesthesia. Patients with poor cooperation, inadvertent ocular movement, and pressure for palpebral closure during the ophthalmic examinations were excluded. The response to administration of topical anesthesia drops immediately before surgery was also assessed to detect those patients with low cooperation or poor compliance.[47]

There was no predictable risk factor for pain scores of 5 and higher. It is possibly a variable related to a patient's individual sensitivity to pain sensation. A patient's past cognitive experiences, cultural background, emotional state, and degree of anxiety affect this perception, and pain may differ from person to person; stimuli that produce intolerable pain in one person could be easily tolerated by another.

In conclusion, topical anesthesia combined with IV sedation and analgesia is useful in some selected cases of posterior vitrectomy needing no scleral buckling procedure and with a short predicted duration of surgery. Larger, prospective controlled studies may be needed to confirm the results related to posterior vitrectomy under topical anesthesia.

References

1. Rao P, Wong D, Groenewald C, et al. Local anaesthesia for vitreoretinal surgery: a case control study of 200 cases. *Eye* 1998; 12:407–11.
2. Demediuk O, Dhaliwal R, Papworth D, et al. A comparison of peribulbar and retrobulbar anesthesia for vitreoretinal surgical procedures. *Arch Ophthalmol* 1995;113:908–13.
3. Sharma T, Gopal L, Parikh S, Shanmugam MP, Badrinath SS, Mukesh BN. Parabulbar anesthesia for primary vitreoretinal surgery. *Ophthalmology* 1997;104:425–8.
4. Friedberg MA, Spellman FA, Pilkerton AR, Perraut LE Jr, Stephens RF. An alternative technique of local anesthesia for vitreoretinal surgery. *Arch Ophthalmol* 1991;109:1615–6.
5. Lai MM, Lai JC, Lee WH, et al. Comparison of retrobulbar and sub-tenon's capsule injection of local anesthetic in vitreoretinal surgery. *Ophthalmology* 2005;112:574–9.
6. Tan CS, Mahmood U, O'Brien PD, et al. Visual experiences during vitreous surgery under regional anesthesia: a multicenter study. *Am J Ophthalmol* 2005;140:971–5.
7. Benedetti S, Agostini A. Peribulbar anesthesia for vitreoretinal surgery. *Retina* 1994;14:277–80.
8. Shah VA, Gupta SK, Chalam KV. Management of vitreous loss during cataract surgery under topical anesthesia with transconjunctival vitrectomy system. *Eur J Ophthalmol* 2003; 13:693–6.
9. Avci R. Cataract surgery and transpupillary silicone oil removal through a single scleral tunnel incision under topical anesthesia; sutureless surgery. *Int Ophthalmol* 2001;24:337–41.
10. Yepez JB, de Yepez JC, Azar-Arevalo O, Arevalo JF. Topical anesthesia with sedation in phacoemulsification and intraocular lens implantation combined with 2-port pars plana vitrectomy in 105 consecutive cases. *Ophthalmic Surg Lasers* 2002; 33:293–7.
11. Yepez J, Cedeno de Yepez J, Arevalo JF. Topical anesthesia in posterior vitrectomy. *Retina* 2000;20:41–5.
12. Yepez J, Cedeno de Yepez J, Arevalo JF. Topical anesthesia for phacoemulsification, intraocular lens implantation, and posterior vitrectomy. *J Cataract Refract Surg* 1999;25:1161–4.
13. Yildirim R, Aras C, Ozdamar A, Bahcecioglu H. Silicone oil removal using a self-sealing corneal incision under topical anesthesia. *Ophthalmic Surg Lasers* 1999;30:24–6.
14. Schipper I, Luthi M. Diplopia after retrobulbar anesthesia in cataract surgery—a case report. *Klin Monatsbl Augenheilkd* 1994;204:176–80.
15. Modarres M, Parvaresh MM, Hashemi M, Peyman GA. Inadvertent globe perforation during retrobulbar injection in high myopes. *Int Ophthalmol* 1997;21:179–85.
16. Magnante DO, Bullock JD, Green WR. Ocular explosion after peribulbar anesthesia: case report and experimental study. *Ophthalmology* 1997;104:608–15.
17. Jackson K, Vote D. Multiple cranial nerve palsies complicating retrobulbar eye block. *Anaesth Intensive Care* 1998;26:662–64.
18. Moorthy SS, Zaffer R, Rodriguez S, Ksiazek S, Yee RD. Apnea and seizures following retrobulbar local anesthetic injection. *J Clin Anesth* 2003;15:267–70.
19. Rosenblatt RM, May DR, Barsoumian K. Cardiopulmonary arrest after retrobulbar block. *Am J Ophthalmol* 1980;90:425–27.
20. Ando K, Oohira A, Takao M. Restrictive strabismus after retrobulbar anesthesia. *Jpn J Ophthalmol* 1997;41:23–6.
21. Cowley M, Campochiaro PA, Newman SA, Fogle JA. Retinal vascular occlusion without retrobulbar or optic nerve sheath hemorrhage after retrobulbar injection of lidocaine. *Ophthalmic Surg* 1988;19:859–61.
22. Morgan CM, Schatz H, Vine AK, et al. Ocular complications associated with retrobulbar injections. *Ophthalmology* 1988; 95:660–5.
23. Meythaler FH, Naumann GO. Direct optic nerve and retinal injury caused by retrobulbar injections. *Klin Monatsbl Augenheilkd* 1987;190:201–4.
24. Hay A, Flynn HW Jr, Hoffman JI, Rivera AH. Needle penetration of the globe during retrobulbar and peribulbar injections. *Ophthalmology* 1991;98:1017–24.
25. Brar GS, Ram J, Dogra MR, et al. Ocular explosion after

peribulbar anesthesia. *J Cataract Refract Surg* 2002;28:556–61.
26. Guise PA. Sub-tenon anesthesia: a prospective study of 6,000 blocks. *Anesthesiology* 2003;98:964–8.
27. Frieman BJ, Friedberg MA. Globe perforation associated with subtenon's anesthesia. *Am J Ophthalmol* 2001;131:520–1.
28. Zehetmayer M, Radax U, Skorpik C, et al. Topical versus peribulbar anesthesia in clear corneal cataract surgery. *J Cataract Refract Surg* 1996;22:480–4.
29. Manners TD, Burton RL. Randomised trial of topical versus sub-tenon's local anaesthesia for small-incision cataract surgery. *Eye* 1996;10(Pt 3):367–70.
30. Kershner RM. Topical anesthesia for small incision self-sealing cataract surgery: a prospective evaluation of the first 100 patients. *J Cataract Refr Surg* 1993;19:290–2.
31. Martin KR, Burton RL. The phacoemulsification learning-curve: per-operative complications in the first 3000 cases of an experienced surgeon. *Eye* 2000;14(Pt 2):190–5.
32. Dinsmore SC. Drop, then decide approach to topical anesthesia. *J Cataract Refract Surg* 1995;21:666–71.
33. Vicary D, McLennan S, Sun XY. Topical plus subconjunctival anesthesia for phacotrabeculectomy: one year follow-up. *J Cataract Refract Surg* 1998;24:1247–51.
34. Frucht-Pery J. Topical anesthesia with benoxinate 0.4% for pterygium surgery. *Ophthalmic Surg Lasers* 1997;28:219–22.
35. Paris V, Moutschen A. Role of topical anesthesia in strabismus surgery. *Bull Soc Belge Ophtalmol* 1995;259:155–64.
36. Eggleston RJ. Surgical repair of multiple ruptures of radial and transverse incisions under topical anesthesia. *J Cataract Refract Surg* 1996;22:1394.
37. Boscia F, La Tegola MG, Columbo G, et al. Combined topical anesthesia and sedation for open-globe injuries in selected patients. *Ophthalmology* 2003;110:1555–9.
38. Yavitz EQ. Topical and intracameral anesthesia for corneal transplants. *J Cataract Refract Surg* 1997;23:1435.
39. Silvera D, Michaeli-Cohen A, Slomovic AR. Topical plus intracameral anesthesia for a triple procedure (penetrating keratoplasty, phacoemulsification and lens implantation). *Can J Ophthalmol* 2000;35:331–3.
40. Riddle HK Jr, Price MO, Price FW Jr. Topical anesthesia for penetrating keratoplasty. *Cornea* 2004;23:712–4.
41. Nielsen PJ, Allerod CW. Evaluation of local anesthesia techniques for small incision cataract surgery. *J Cataract Refract Surg* 1998;24:1136–44.
42. Virtanen P, Huha T. Pain in scleral pocket incision cataract surgery using topical and peribulbar anesthesia. *J Cataract Refract Surg* 1998;24:1609–13.
43. Brucker AJ, Saran BR, Maguire AM. Perilimbal anesthesia for pars plana vitrectomy. *Am J Ophthalmol* 1994;117:599–602.
44. Yanyali A, Celik E, Horozoglu F, Oner S, Nohutcu AF. 25-gauge transconjunctival sutureless pars plana vitrectomy. *Eur J Ophthalmol* 2006;16:141–7.
45. Rizzo S, Genovesi-Ebert F, Murri S, et al. 25-gauge, sutureless vitrectomy and standard 20-gauge pars plana vitrectomy in idiopathic epiretinal membrane surgery: a comparative pilot study. *Graefes Arch Clin Exp Ophthalmol* 2006;19:1–8.
46. Fuji GY, De Juan EJR, Humayun MS, et al. A new 25-gauge instrument system for transconjunctival sutureless vitrectomy surgery. *Ophthalmology* 2002;109:1807–12.
47. Fraser SG, Siriwadena D, Jamieson H, Girault J, Bryan SC. Indicators of patient suitability for topical anesthesia. *J Cataract Refract Surg* 1997;23:781–83.

Key words: topical anesthesia, posterior vitrectomy