

Combined Topical and Intracameral Anesthesia in Penetrating Keratoplasty

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Background: The standard of care for penetrating keratoplasty (PKP) is either retrobulbar or peribulbar anesthesia combined with seventh cranial nerve akinesia or general anesthesia. These methods are known to be associated with rare but potentially serious adverse ocular and systemic events.

Purpose: To determine the safety and efficacy of combined topical and intracameral anesthesia in addition to intravenous sedation for repeat penetrating keratoplasty (PKP).

Setting: Tertiary-care university hospital.

Methods: In this prospective study, combined topical tetracaine 0.5% and 0.2 cc intracameral 1% lidocaine along with IV sedation with midazolam and fentanyl were used for patients undergoing repeat PKP in 15 eyes of 15 selected patients. The indication for surgery was failed corneal graft. Verbal pain scale (VPS, 0–3) was recorded preoperatively, intraoperatively at 3 time-points (after trephination, after placing 8 interrupted sutures, and after placing the running suture), and postoperatively (1 hour postoperatively, overnight pain, and 1 day postoperatively). Patient and surgeon satisfaction were assessed postoperatively using a scale (1–5). After surgery patients were asked for their preferences comparing the current use of topical anesthesia compared with retrobulbar anesthesia used for their initial PKP.

Results: The mean intraoperative VPS score was 0.51 ± 0.32 (range 0–1.33), and the mean postoperative VPS score was 0.47 ± 0.50 (range 0–1.67). There were no serious intraoperative or postoperative complications. All patients reported high mean satisfaction score of 4.67 ± 0.49 (range 4–5). The mean satisfaction score reported by the surgeon was 4.47 ± 0.63 (range 3–5). All patients but 1 (93.3%) preferred combined topical over retrobulbar anesthesia, which they had in their previous surgery.

Conclusions: We found combined topical and intracameral anesthesia to be safe and effective in our selected group of patients undergoing repeat PKP, and it may provide a satisfactory alternative anesthetic modality for patients in whom general, retrobulbar, or peribulbar anesthesia may be contraindicated.

Key Words: retrobulbar, intracameral, and topical anesthesia, repeat PKP

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Penetrating keratoplasty (PKP) is traditionally performed under regional block or general anesthesia. Retrobulbar and peribulbar anesthesia techniques are invasive and can be painful during administration of the injection.^{1–3} These techniques carry risks of rare but severe complications such as globe perforation, retrobulbar hemorrhage, optic nerve damage, dural perforation and subdural injection, retinal vascular obstruction, extraocular muscle dysfunction, ptosis, diplopia, respiratory arrest, and increased blood pressure.^{4–7}

Topical anesthesia for phacoemulsification has become increasingly popular, primarily because it eliminates many of the potential complications associated with regional block.^{8–11} Recently the application of topical anesthesia for phacotrabeculectomy in patients with primary open angle glaucoma and coexisting cataract has been reported to be effective.¹² To our knowledge there are only 2 case reports in the literature describing the use of topical plus intracameral anesthesia for a triple procedure (PKP, phacoemulsification, and IOL implantation).^{13–14}

In addition to safety, another important factor to be considered by the physician when choosing the type of anesthesia is the pain or discomfort experienced by the patient during the surgery. The purpose of this study was to determine the safety and efficacy of combined topical and intracameral anesthesia for penetrating keratoplasty in carefully selected cases. All patients underwent repeat PKP, which served 2 purposes: first, because trigeminal nerve endings have already been severed before, we assumed it would be less painful; and second, all patients had their previous corneal transplant under retrobulbar anesthesia, which allowed for a comparison between these 2

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anesthetic modalities. This study prospectively assessed patient comfort and surgeon and patient satisfaction.

PATIENTS AND METHODS

In this study we prospectively evaluated 15 selected patients who underwent repeat PKP under combined topical plus intracameral anesthesia. The criteria for inclusion were: age 19 years or older, clear communication between patient and surgeon, and ability to easily conduct an ocular examination. Patients were excluded if they suffered from dementia or a psychiatric or cognitive disorder, were unable to communicate clearly, had a significant ocular complication with previous intraocular surgery, were excessively anxious, had an excessive blink reflex during intraocular pressure measurement by Goldman applanation tonometry, had nystagmus, or had an allergy to fentanyl or midazolam. All patients received a thorough explanation of the procedure and what they might experience during the operation. Patients were informed that they may be aware of some sensation of touch and/or pressure and that they would be able to see the microscope light during the operation. All patients signed an informed consent form approved by our Institutional Research Board.

Topical 0.5% tetracaine drops were administered twice into the conjunctival sac 15 minutes preceding surgery, and an additional 2 drops immediately preoperatively. Patients' vital signs were monitored by an anesthesiologist throughout the operation. All patients received intravenous sedation consisting of 0.01–0.03 mg/kg midazolam and 0.5–2 µg/kg fentanyl. The mean doses of midazolam and fentanyl were 0.025 mg/kg and 0.97 µg/kg, respectively. All surgeries were performed by the

same surgeon (A.R.S.). All patients received a modified Van-Lint akinesia injection consisting of 2 mL of 2% lidocaine without epinephrine.

After standard aseptic preparation, a lid speculum was inserted, and the recipient cornea was measured. The donor corneal button was cut using an 8-mm Hannah trephine. A full-thickness corneal incision using a 75 Beaver blade was made at the graft–host junction for a length of 2 clock hours (9–11 o'clock). Preservative-free 1% lidocaine, 0.3 mL, was then injected into the anterior chamber, and the anterior chamber was filled with a viscoelastic agent (Viscoat, Alcon Canada Inc). The corneal button was excised with right and left corneal scissors. The donor tissue was placed into the recipient site and sewn into place with a combination of 8 interrupted 10-0 nylon sutures and a running 16-bite 10-0 nylon suture. At the end of surgery, 0.5 mL of cefazolin was injected subconjunctivally. Some patients required intraoperative synechiolysis or anterior vitrectomy (Table 1). Postoperatively, the eye was not patched, and the patient was instructed to start topical treatment with antibiotic and steroids that same day.

Pain Assessment

Before surgery, patients were instructed about the 4-point verbal pain scale (VPS), which was to be used to evaluate their subjective experience of pain: 0 = no pain; 1 = mild pain; 2 = moderate pain; and 3 = severe pain. Patients were asked to rate their subjective experience of pain at baseline (preoperatively), after insertion of the lid speculum, and at 3 specific time points during surgery: after host cornea trephination, after the 8 interrupted sutures were placed and the knots

TABLE 1. Patient Demographics

Patient Number	Age (years)	Gender	Eye	CGV	PAS	Previous Surgery	Current Surgery
1	64	F	R	–	+	PKP + PAS lysis	PKP + PAS lysis
2	40	M	L	–	–	PKP + 2 ^o IOL impl.	PKP
3	62	F	R	–	–	PKP + Phaco + IOL	PKP
4	84	F	L	–	+	PKP + IOL exchange	PKP + PAS lysis
5	73	F	R	–	–	PKP + IOL exchange + PAS lysis	PKP
6	81	F	R	–	–	PKP	PKP
7	72	F	L	–	+	PKP + Phaco + IOL	PKP + PAS lysis
8	71	M	L	–	–	PKP + Phaco + IOL	PKP
9	76	F	L	–	–	PKP	PKP
10	73	F	L	+	–	PKP	PKP
11	37	M	L	–	–	PKP	PKP
12	88	M	L	–	–	PKP	PKP
13	69	F	R	–	+	PKP	PKP
14	74	F	L	–	–	PKP	PKP
15	83	F	R	+	–	PKP	PKP

CGV, corneal graft vascularization; PAS, peripheral anterior synechia; PKP, penetrating keratoplasty; Phaco, phacoemulsification.

rotated, and after placement of the running suture. The overall intraoperative pain score was determined by the average of the VPS at the 3 surgical points. Patients were instructed to inform the investigators if they experienced pain at any point during the surgery. Any patient experiencing more than mild pain was given additional topical tetracaine. Intraoperative data on the use of supplementary anesthetic agents and patient-reported pain were recorded. Postoperative pain was assessed by an independent investigator in the recovery area without the presence of the surgeon, using the VPS 1 hour postsurgery. The next morning, during their visit, patients were asked to assess pain overnight and that morning. Patient satisfaction was assessed that morning by the same investigator using a 5-point satisfaction scale: 1 = extremely dissatisfied; 2 = dissatisfied; 3 = neither satisfied nor dissatisfied; 4 = satisfied; 5 = extremely satisfied. In addition, the patients were questioned postoperatively as to whether they preferred the current topical plus intracameral anesthesia used for their regrant or the retrobulbar anesthesia used for their initial surgery.

The surgeon also completed an assessment immediately after each operation, rating the overall surgical conditions and patient cooperation using the 5-point satisfaction scale: 1 = extremely dissatisfied; 2 = dissatisfied; 3 = neither satisfied nor dissatisfied; 4 = satisfied; 5 = extremely satisfied. Surgical complications were also recorded.

RESULTS

Patient demographic data, including their previous ocular surgery, are summarized in Table 1.

The mean overall intraoperative VPS was 0.51 ± 0.32 , range from 0 to 1.33 (scale 0 to 3). Eighty percent of patients reported no or only mild intraoperative pain. Pain scores at baseline, after lid speculum insertion, and at each of the 3 stages during surgery are shown in Table 2. Intraoperatively, the highest mean pain score was recorded following placement of the running suture (VPS = 0.73). The mean VPS following host trephination and postplacement of the interrupted sutures was 0.27 (range 0 to 1) and 0.53 (range 0 to 2), respectively. After host trephination 80% of patients (12 eyes) reported no pain, and the rest reported only mild pain (Fig. 1). After placement of the interrupted sutures only 1 patient reported moderate pain, which was correlated with a suture that extended to the limbus. Additional topical tetracaine 0.5% was used for 6 patients who reported pain during surgery. No patient received additional intracameral lidocaine injection.

The mean overall postoperative VPS was 0.47 ± 0.50 (range 0 to 1.67). The postoperative pain level was scored as none or mild by 12 patients (80%). One hour after surgery, 13 patients reported no or mild pain. Two patients reported moderate pain. One patient reported severe pain overnight.

The mean patient satisfaction score (scale 1 to 5) was 4.67 ± 0.49 (range 4 to 5). All patients had their previous penetrating keratoplasty (Table 1) performed using retrobulbar anesthesia. After surgery patients were asked for their preference, comparing the current use of topical plus intracameral anesthesia for their repeat PKP versus retrobulbar anesthesia used for their initial PKP. All patients except 1 favored topical plus intracameral lidocaine. The mean surgeon satisfaction

TABLE 2. Intra- and Postoperative Pain Scores

Patient No.	Post Lid Speculum (baseline)	Intraoperative Pain Score				Postoperative Pain Score			
		Post Host Trephination	Post Interrupted	Post Running	Average	1 h Postop	Overnight	1 day Postop	Average
1	0	1	0	1	0.67	1	0	1	0.67
2	0	0	1	1	0.67	0	1	1	0.67
3	0	1	0	0	0.33	0	0	0	0
4	0	1	1	2	1.33	1	1	0	0.67
5	1	0	0	0	0	0	1	0	0.33
6	0	0	2	1	1	1	0	0	0.33
7	0	0	1	2	1	0	0	0	0
8	0	0	1	0	0.33	1	1	1	1
9	0	0	0	0	0	0	0	0	0
10	1	0	0	1	0.33	0	0	0	0
11	0	0	1	1	0.67	2	3	0	1.67
12	0	0	0	1	0.33	0	0	0	0
13	0	1	1	1	1	0	2	1	1
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	2	0	0	0.67
All	0.13	0.27	0.53	0.73	0.51	0.53	0.6	0.27	0.47

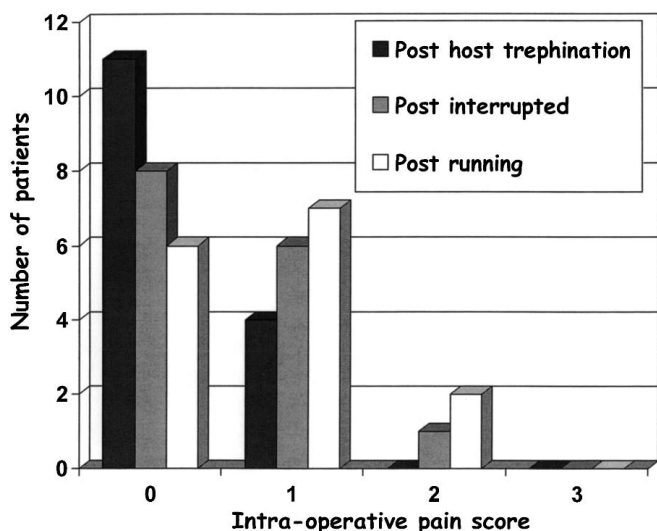


FIGURE 1. Intraoperative verbal pain scores (VPS) in different stages.

score was 4.4 ± 0.63 (range 3 to 5) (Fig. 3). Surgeon satisfaction was rated as satisfied or extremely satisfied in 14 (93%) PKPs and as neither satisfied nor dissatisfied in 1 PKP.

There were no significant intraoperative or postoperative complications. One patient (no. 7) had a small (superotemporal) zonular dehiscence with slight dislocation of the PCIOL. The intraocular lens was easily repositioned into place, and an anterior vitrectomy was not required.

DISCUSSION

In the present study, topical and intracameral anesthesia combined with intravenous sedation was found to be safe and

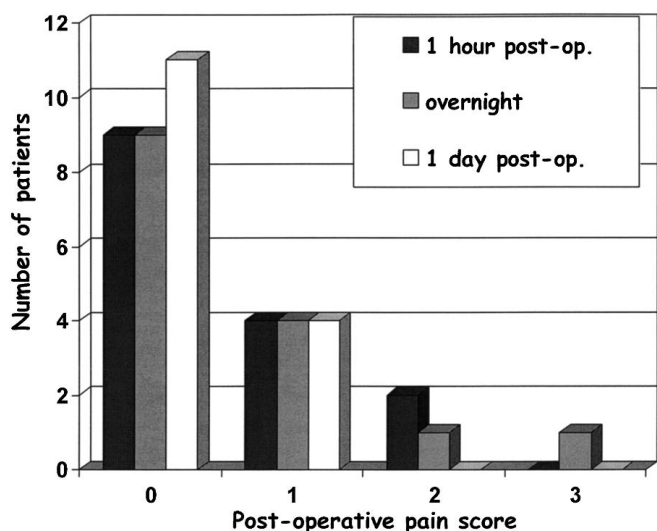


FIGURE 2. Postoperative pain scores in different stages: 1 hour after surgery, overnight pain, and 1 day after surgery.

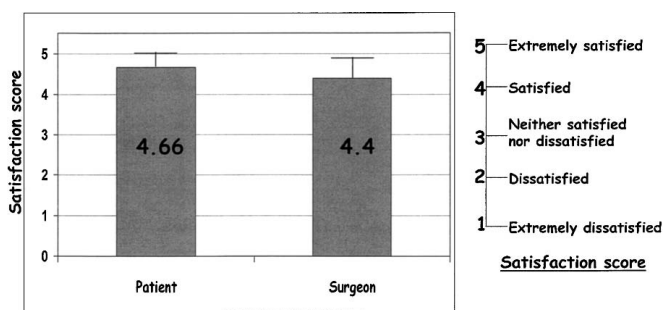


FIGURE 3. Patient and surgeon satisfaction scores.

effective in a selected group of patients undergoing repeat PKP.

The reported use of topical anesthesia for phacoemulsification and phacotrabeculectomy has been increasing.^{12,15-18} A significant advantage of using topical anesthesia is that it eliminates the rare but severe complications that may be associated with retrobulbar or peribulbar anesthesia, such as intravascular or intrathecal injection, globe perforation, optic nerve trauma, retrobulbar hemorrhage, respiratory depression, and death.^{17,19} It also eliminates the possibility of a retrobulbar hemorrhage, which in most cases would require cancellation and postponement of surgery. Moreover, retrobulbar and peribulbar injections are reported by patients to be moderately to severely painful.¹⁹

To the best of our knowledge, this study is the first prospective evaluation of the safety and efficacy of combined topical and intracameral anesthesia as an alternative to peribulbar or retrobulbar anesthesia in a select group of patients undergoing repeat penetrating keratoplasty. The highest mean intraoperative verbal pain score (VPS) was recorded toward the end of the operation, ie, after placement of the running suture. In studies looking at patients' subjective experience of pain during phacoemulsification surgery with topical anesthesia, several authors have also observed higher pain scores in the later steps of the operation.^{20,21} It appears likely that the duration of the anesthetic effect of topical tetracaine 0.5% plus intracameral 1% lidocaine becomes less effective during the later part of the operation. For this reason, it is the authors' opinion that the anesthetic modality be used by experienced cornea surgeons and not those beginning to perform corneal transplantation. Further studies using lidocaine 2% gel, which may provide prolonged contact time with the ocular surface, or with multiple injections of intracameral lidocaine throughout the operation are required to see if the same analgesic effect can be maintained for the entire duration of the surgery.^{22,23} Recently, Yopez et al reported the use of topical anesthesia with sedation for phacoemulsification combined with 2-port pars plana vitrectomy to be safe and effective.²³ In the present study we also evaluated the postoperative pain scores within the first 24 hours after surgery. Most of the patients reported no

or mild pain postoperatively. Only 2 patients reported moderate pain 1 hour after surgery, 1 of them reporting severe pain overnight. A second patient had moderate pain overnight. Our patients were limited by our study protocol from taking any postoperative analgesia within the first 24 hours. This study also demonstrates the importance of providing adequate postoperative analgesia control for patients undergoing topical PKP, as we usually do with patients who undergo corneal transplantation under retrobulbar or general anesthesia. Should we have given the usual postoperative analgesic therapy, we postulate that pain control in these patients might have been even better. Patient sedation is very important in considering who would or would not be a good candidate for topical PKP surgery. Patients should be able to communicate clearly with their surgeon.

Possible scenarios when one may consider using topical plus intracameral anesthesia for penetrating keratoplasty may be in the high risk patient who is receiving anticoagulant therapy in whom discontinuation of treatment would be contraindicated.^{24,25} These individuals are at a higher risk of retrobulbar hemorrhage. Another scenario where topical plus intracameral anesthesia may be considered is in the patient requiring PKP surgery for corneal perforation. Retrobulbar injections are typically contraindicated in this setting. Many of these patients are elderly with associated other significant medical conditions, and general anesthesia for these patients may be associated with increased morbidity and mortality.

The limitations of this study include a small sample size and lack of a comparative control group having the surgery using traditional retrobulbar or peribulbar anesthesia.

In summary, we found that topical plus intracameral anesthesia combined with intravenous sedation was safe and effective in a selected group of patients undergoing repeat PKP surgery. Important factors to consider are the level of experience of the surgeon and patient selection criteria.

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