

Comparison of sub-Tenon's anaesthesia by different delivery techniques in cataract surgery

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Abstract

Purpose To compare the analgesic effects of three different delivery techniques of sub-Tenon's anaesthesia in cataract surgery by assessing patients' response to the visceral stimulus.

Methods A prospective, randomised study was conducted on 345 eyes of 345 patients undergoing phacoemulsification and posterior chamber intraocular lens implantation. They received anaesthetic infiltration into the sub-Tenon's space through a conjunctival incision (115 eyes), infiltration into the posterior sub-Tenon's space (retrobulbar space) through a conjunctival incision (114 eyes), or injection into the intra-Tenon's space (subconjunctival space) without making a conjunctival incision (116 eyes). Pain scores were recorded when the anterior chamber was irrigated with an acetylcholine chloride solution to achieve miosis after lens implantation.

Results There were no significant differences in pain scores among the three groups (chi-squared test of homogeneity, $p = 0.814$).

Approximately 10–20% of patients reported slight to severe pain at the time of acetylcholine administration.

Conclusions The three anaesthetic delivery methods of sub-Tenon's anaesthesia possess similar and reasonable analgesic effects in cataract surgery, but may not block visceral stimuli completely.

Key words Acetylcholine, Cataract surgery, Local anaesthesia, sub-Tenon's anaesthesia, Visceral pain

The efficacy of sub-Tenon's anaesthesia has been well documented in cataract surgery,^{1–18} vitreoretinal surgery,^{12,19–21} retinal photocoagulation,²² trabeculectomy¹² and strabismus surgery.²³ Several delivery techniques of sub-Tenon's anaesthesia have been reported, including injection of anaesthetic into the sub-Tenon's space after making a conjunctival incision,^{3,7,18,21} injection of

anaesthetic into the posterior sub-Tenon's space (retrobulbar space) after making a conjunctival incision^{1,2,11,13,16,19,20,23} and injection of anaesthetic into the intra-Tenon's space (subconjunctival space) without making a conjunctival incision.^{5,22,24–31} The difference in the analgesic effects of these methods, however, has never been investigated. The current prospective, randomised study was conducted to compare the effects of sub-Tenon's anaesthesia using different delivery techniques by assessing the patients' response to a visceral stimulus during cataract surgery.

Subjects and methods

A prospective study was conducted on 345 eyes of 345 patients undergoing phacoemulsification and posterior chamber intraocular lens implantation between February 1994 and December 1994 at Shin-Kawabashi General Hospital, Kanagawa, Japan. When the patient was bilaterally treated, the eye that was first operated on was selected for the study. Exclusion criteria were previous intraocular surgery, apparent ocular pathologies other than age-related cataract, intraoperative complications, and inability to communicate during surgery. Written informed consent was obtained pre-operatively from all patients.

One surgeon (Y.T.) performed all anaesthetic procedures and surgery. The patients were randomly assigned to one of the three anaesthetic methods as follows.

1. *Conventional sub-Tenon's anaesthesia* (115 eyes). The conjunctiva was anaesthetised with a topical application of 4% lidocaine (Xylocaine, Fujisawa Pharmaceutical, Osaka, Japan) and a limbal conjunctival incision was made. A 22 mm, 27 gauge, curved blunt needle was inserted into the superotemporal sub-Tenon's space, and passed posteriorly on the sclera to the equatorial area of the globe, where 1.0 ml of 2% lidocaine was infiltrated.
2. *Posterior sub-Tenon's anaesthesia* (sub-Tenon's administration of retrobulbar anaesthesia) (114 eyes). The conjunctiva was anaesthetised

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Commercial or proprietary
interest: None

Received: 18 February 1999

Accepted in revised form:
4 June 1999

with a topical application of 4% lidocaine and a limbal conjunctival incision was made. A 22 mm, 27 gauge, curved blunt needle was inserted into the superotemporal sub-Tenon's space, and passed posteriorly by approximately 20 mm from the limbus on the sclera to reach the retrobulbar space, where 1.0 ml of 2% lidocaine was infiltrated.

3. *Intra-Tenon's anaesthesia* (subconjunctival anaesthesia) (116 eyes). The conjunctiva was anaesthetised with a topical application of 4% lidocaine. The conjunctiva approximately 7 mm from the superotemporal limbus was elevated with forceps, and a 27 gauge needle was inserted subconjunctivally and passed posteriorly for 5 mm, where 1.0 ml of 2% lidocaine was injected.

Patients in each group received the same routine pre-operative medications. Pre-operative pupillary dilation was accomplished using topical 5% phenylephrine and 0.5% tropicamide (Mydrin-P, Santen Pharmaceutical, Osaka, Japan), which was given at 30 min intervals starting 3 h before surgery. Nonsteroidal anti-inflammatory agents were not administered. Intravenous or oral sedatives were not used.

In each patient, cataract surgery was performed using the same techniques, which included creation of a fornix-based conjunctival flap, 5.0 mm scleral tunnel incision, continuous curvilinear capsulorhexis, bimanual in-the-bag phacoemulsification, aspiration of the cortex, implantation of a 5.5 mm optic polymethylmethacrylate posterior chamber intraocular lens in the capsular bag, and suturing of the scleral incision with single crossed 10-0 nylon suture.

Immediately after implanting the posterior chamber intraocular lens, the anterior chamber was irrigated with 1.0 ml of 2.5% acetylcholine chloride (Ovisot, Daiichi Pharmaceutical, Tokyo, Japan) solution to achieve pupillary miosis. On confirming miosis, the patient was asked to grade the degree of sensation induced by the administration of acetylcholine chloride. Grading was done on a subjective four-step scale, which had been explained to the patients pre-operatively: no sensation and no pain, slight sensation but no pain, slight pain, and moderate to severe pain. The anterior chamber was washed to remove the viscoelastics and acetylcholine after the query.

Results

The background data of the patients were compared among the three groups (Table 1). There were no significant inter-group differences in terms of male/female ratio, age or operating time. In no group were there any intraoperative complications attributable to insufficiency of the anaesthetic effects.

The pain scores in each anaesthesia group are shown in Table 2. Approximately 30% of patients reported no sensation at the time of acetylcholine administration, and 10–20% complained of slight pain. The data were statistically analysed using a chi-squared test of homogeneity with the small numbers in row 4 (moderate

Table 1. Patient data

	Posterior		
	Sub-Tenon's anaesthesia	sub-Tenon's anaesthesia ^a	Intra-Tenon's anaesthesia ^b
Eyes	115	114	116
Male/female	44/71	45/69	45/71
Age (years)	71.3 ± 9.8	71.1 ± 10.8	71.1 ± 10.6
Operating time (min)	14.3 ± 3.1	14.6 ± 3.1	14.3 ± 3.4

Values are the mean ± standard deviation.

^aSub-Tenon's administration of retrobulbar anaesthesia.

^bSubconjunctival anaesthesia.

to severe pain) of Table 2 merged with row 3 (slight pain) making a 3 × 3 table. There were no significant differences in the pain scores among the three anaesthetic delivery methods ($p = 0.814$). A similar result was obtained when the Kruskal-Wallis test was applied on the 3 × 4 table ($p = 0.832$).

Discussion

We compared the analgesic effects of three delivery techniques of sub-Tenon's anaesthesia by assessing patients' reports of sensation induced by acetylcholine chloride. Acetylcholine is known to evoke visceral pain on administration into the anterior chamber,^{32–34} and thus is thought to be an adequate visceral stimulus.³⁵ The patients were pre-operatively informed about the nature of stimulus, and the method of grading sensation was explained. We used a similar concentration and amount of acetylcholine solution as had been routinely used at the institution before the current study.

As shown in the results, there was no significant difference in the pain scores of the three groups, indicating that the three anaesthetic delivery methods possess similar analgesic effects in cataract surgery. Tenon's capsule is the anterior extension of the visceral layer of dura investing the optic nerve,³⁶ and thus the sub-Tenon's space is, in effect, an anatomical pathway from the limbus to the retrobulbar space. A magnetic resonance imaging study demonstrated that anaesthetic delivered into the sub-Tenon's space swiftly spread from the limbus around the rectus muscle to the optic nerve sheath.³⁷ As seen during surgery, the adhesion between Tenon's capsule and the sclera is loose, and thus it may be that there is little resistance against the posterior excursion of the anaesthetic once infused into the sub-Tenon's space.

Table 2. Pain scores

	Posterior		
	Sub-Tenon's anaesthesia	sub-Tenon's anaesthesia ^a	Intra-Tenon's anaesthesia ^b
No sensation	35 (30.4%)	33 (28.9%)	34 (29.3%)
Slight sensation but no pain	61 (53.0%)	59 (51.8%)	66 (56.9%)
Slight pain	18 (15.7%)	22 (19.3%)	15 (12.9%)
Moderate to severe pain	1 (0.9%)	0	1 (0.9%)

^aSub-Tenon's administration of retrobulbar anaesthesia.

^bSubconjunctival anaesthesia.

While the majority of patients who received sub-Tenon's anaesthesia reported no pain (slight sensation) at the time of acetylcholine administration, slight to severe pain was induced in approximately 10-20% of patients. On the other hand, except for the time of acetylcholine administration, very few patients complained of pain and/or discomfort during the entire course of surgery. These findings suggest three things. First, acetylcholine represents an adequate and strong visceral stimulus in the intraocular environment. Secondly, modern cataract surgery employing phacoemulsification does not elicit severe visceral pain. Thirdly, sub-Tenon's anaesthesia possesses reasonable analgesic effects but can not block visceral stimuli completely. Thus, the performance of a pain-free operation does not necessarily verify the complete analgesic effects of anaesthesia because it is possible that the anaesthesia was insufficient but no adequate stimulus was evoked during surgery. In modern cataract surgery there has been a trend towards less extensive anaesthetic methods.³⁸ Surgeons should not be overconfident regarding the effects of anaesthesia, but be prepared for the situations where some form of visceral stimulus is anticipated during surgery.

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