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Intracameral anesthesia for cataract surgery: a population-based study on patient satisfaction and outcome

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Purpose: To evaluate if the standard anesthetic regimen – topical combined with intracameral anesthesia without sedation – in a population-based cohort of unselected cataract surgery cases is adequate, optimal, and good practice, or if improvements are necessary.

Methods: We conducted a prospective, observational study on all cases of cataract surgery during a 1-year period at one institution (n=1249). Data were collected from the patients' records. Outcome measures were use of preoperative sedation, type of anesthesia, complications, and adverse events. In a subgroup of patients (n=124) satisfaction with the anesthetic regimen was evaluated using a short questionnaire.

Results: Most cases (90%, 1125/1249) had combined topical and intracameral anesthesia without sedation. Patients who chose preoperative sedation (midazolam hydrochloride sublingually) were significantly younger and more often female ($P=0.0001$ and $P=0.011$, respectively). In the questionnaire subgroup, the median pain score after surgery was 0.7 (visual analog scale, 0–10). A pain score of 1.9 or less was reported by 76% of the patients. Patients reporting a pain score of 2 or more had sedation and additional anesthetics more often. No significant difference was found regarding age, sex, pulse rate, oxygen saturation, first or second eye surgery, or adverse intraoperative events for patients with pain scores of 1.9 or less and 2 or more.

Conclusion: This large population-based series of small-incision phacoemulsification surgery shows that combined topical and intracameral anesthesia without sedatives is well tolerated for most phacoemulsification patients. It is also effective in cases when complications or adverse events occur. It is important to be responsive to the individual patient's needs and adjust operating procedures if necessary, as there were a few patients who experienced insufficient anesthesia.

Keywords: anesthesia, local/methods, phacoemulsification, cataract extraction, humans, prospective observational studies

Introduction

Cataract surgery is one of the most commonly performed elective surgical procedures in Europe and the US.^{1,2} In Sweden, more than 94,000 operations were performed in 2011, of which 42% were second eye surgery.³ As a consequence of the large number of operations performed worldwide, it is important that all parts of the procedure are rational and cost-effective.

A low-risk anesthetic regime adequate for the majority of patients is important for efficient patient care. There should only be a few cases needing another anesthetic procedure, as decided by the surgeon on the operating day.

There are currently several options for anesthesia in cataract surgery, and a great variation of routines among centers.^{4–8} The more resource-demanding techniques, such

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as regional anesthesia, are still widely used worldwide, most commonly as peribulbar or sub-Tenon injections. General anesthesia has a well-established role when local anesthetics are deemed unsuitable, but is usually needed in only a few cases. Topical and intracameral anesthesia have been shown to be safe and effective alternatives to regional anesthesia.⁹ They allow rapid visual recovery and avoid rare but potentially serious complications, such as globe perforation or retrobulbar hemorrhage.^{10–12}

Topical anesthesia has found large acceptance both in the US and Europe, because it is cost-effective, provides high patient comfort during surgery,^{7,13} and is less stressful for the patient compared with regional anesthesia.^{14,15} However, patient discomfort has been reported during specific points of topical surgery, usually involving direct iris manipulation or movement of the iris diaphragm due to rapid hydrodynamic changes, and at intraocular lens insertion. To relieve this type of discomfort, 1% unpreserved lidocaine 0.1–0.5 mL can be injected into the anterior chamber, ie, intracameral anesthesia.^{8,13}

The purpose of the present study was to analyze the anesthetic regimen and sedation in a population-based cohort of unselected cataract-surgery cases. We aim to evaluate if the standard anesthetic regimen of the clinic (topical combined with intracameral anesthesia, mostly without sedation) is adequate, optimal, and good practice, or if improvements are necessary. We focus on the need for supplementary anesthetic procedures, need for preoperative sedation, and patient satisfaction.

Materials and methods

Study population

All patients having cataract surgery at Sunderby Hospital, Luleå, Sweden during a 1-year period – June 1, 2010 to May 31, 2011 – were prospectively registered. The admitting area represents 1.8% of the Swedish population and is sparsely populated, with long distances to travel for many patients. There are no private operating clinics in the area. Only a few patients living in the admitting area were operated on at another eye clinic during the time period studied (18 of 1,267, 1%). More than 99% of the patients were Caucasian. All patients provided informed consent. The study complied with the tenets of the Declaration of Helsinki and was approved by the local ethics committee.

Patients who underwent cataract surgery combined with other surgical procedures were excluded. The study included a total of 1,249 senile and presenile cataract-surgery cases in 1,114 patients. A total of 135 patients had cataract surgery

on both eyes during this 1-year period, of which 13 patients had same-day surgery on both their eyes. Patient data were collected from the records, which for cataract surgery are standardized at the clinic.

Standard anesthetic regime

The standard anesthetic regime is combined topical with additional intracameral anesthesia without preoperative sedation. In detail, the standard routine is as follows. Most patients administer dilating drops at home, phenylephrine 2.5% and cyclopentolate 1%, one drop, three times each, 15 minutes apart, starting 1 hour before leaving their homes. On arrival at the clinic, the admitting nurse checks the patient's identity, and if necessary administers additional mydriatic drops. The admitting nurse also asks each patient if they feel calm and relaxed. If they express any anxiety, they are asked if they would prefer any preoperative sedation. Those who want sedation have midazolam hydrochloride sublingually on arrival at the operating theater. The dose is determined by patients' age and body weight, and most patients receive 2–3 mg.

One drop of preservation-free amethocaine hydrochloride (1%) is given before rinsing the eye with chlorhexidine solution (0.5 mg/mL). A few minutes later at the operating theater, another drop of amethocaine hydrochloride (1%) is administered by the assisting nurse before the skin is cleaned and the eye draped. A small dose (0.2 mL) of preservative-free lidocaine hydrochloride (10 mg/mL 1%) is administered intracamerally by the surgeon at the beginning of the surgery. If the patient experiences pain during the surgical procedure, additional anesthetics are administered, either topical amethocaine hydrochloride (1%) drops and/or additional intracameral lidocaine hydrochloride (1%).

A routine cataract surgical procedure at the clinic does not involve an intravenous line and is performed without any anesthesiologist's supervision. There are anesthesiologists present at the hospital and available if any emergency should occur. The only monitoring used during surgery is a pulse/oxygen-saturation meter, which was used in most cases. Except for the surgeon, the staff consists of one surgical nurse and one assisting nurse, who also check the well-being of the patient during surgery.

Standard surgical procedure

Standard cataract surgery at our clinic at the time of the study was clear corneal small-incision (2.75 mm) phacoemulsification (PE) with a foldable intraocular lens. Six experienced consultants conducted the operations. Surgical volume ranged from 18 to 25 cases per month and surgeon.

Patient-satisfaction questionnaire subgroup

A total of 133 consecutive cases (11% of the total) had surgery during the 1-month period the satisfaction study was conducted. These patients answered a questionnaire regarding their experience and satisfaction with the anesthetic regimen. One patient was excluded from the questionnaire because of dementia; 124 of 132 (94%) accepted, and eight declined to participate.

The patients were informed by the operating staff, and received the questionnaire directly after completed surgery. The patients answered the questionnaire and put them into a box before leaving the clinic. To evaluate the change with time regarding their experience (memory) of the surgery, the same questionnaire was mailed to the patients 6 weeks postoperatively. Ninety-seven percent of the patients (120 of 124) answered the same questionnaire again. Table 1 lists the questions asked in the questionnaire.

Statistical methods

The independent-samples *t*-test was used to compare the mean age, pulse rate, and oxygen saturation between groups. Yates's corrected χ^2 tests or Fisher's exact tests were used to analyze the two-by-two tables, when appropriate. All tests were two-sided, and $P < 0.05$ was considered statistically significant. Statistical analysis was performed using SPSS for MS Windows software (version 19.0; IBM, Armonk, NY, USA).

Table 1 Questions of the satisfaction questionnaire (translated from Swedish)

Please answer some questions regarding your experience of the cataract surgery

- Approximately how painful was your cataract surgery?
 No pain at all Unbearable pain

 Put a mark on the line according to the degree of experienced pain
- I believe I got too little anesthesia
 just enough anesthesia
 too much anesthesia
- If you didn't get any preoperative sedation, would you have needed some, do you think?
 Yes
 No
- If you have cataract surgery again, will you choose the same anesthetic method?
 Yes
 No

Results

Demographics

The mean age of the 1,249 cataract surgery cases included was 74.1 years (standard deviation 9.6, range 22–96); 41% were males and 59% were females. Of these, 777 cases (62%) had had cataract surgery for the first time, 446 cases (36%) were second eye surgery, and 26 cases (2%) had bilateral cataract surgery on the same day. All patients had day-case surgery.

Sedation and anesthesia

Tables 2 and 3 show the type of anesthesia used and the frequency of preoperative sedation. The reasons for using general anesthesia included mental retardation ($n=4$), extreme nervousness ($n=3$), neurological disease with severe head shaking ($n=1$), and traumatic cataract ($n=1$). Peribulbar anesthesia was given in one case with complications requiring conversion to extracapsular cataract surgery. Sub-Tenon's anesthesia was given in one case because of preoperatively anticipated need for extensive iris manipulations in a small-pupil case with allergy to mydriatics, and in two cases it was given perioperatively to enhance anesthesia in complicated operations requiring conversion to extracapsular cataract surgery.

Women and younger patients had a significantly higher need for preoperative sedation compared with males and older patients ($P < 0.000$ and $P = 0.001$, Yates's corrected χ^2 test and independent-samples *t*-test, respectively) (Table 3).

Supplementary anesthetics, as additional doses of topical and/or intracameral anesthesia, were needed more often in patients who had no preoperative sedation compared with patients who had preoperative sedation (7% [82 of 1,146] and 3% [three of 94], respectively; $P = 0.21$); however, this difference was not significant. In most cases, additional topical anesthetic amethocaine hydrochloride drops (1%) were sufficient to control patient discomfort. Thirteen percent of the patients (eleven of 85) needed additional intracameral anesthesia, all from the group without preoperative sedation.

Table 2 Distribution of the types of anesthesia used

Type of anesthesia	Number of cases	Percentage
Topical only	14	1.1
Topical + intracameral	1,219	97.7
Sub-Tenon's	3	0.2
Peribulbar	1	0.1
General anesthesia	9	0.7
Unknown	3	0.2
Total	1,249	100

Table 3 Preoperative sedation

Sedation	Number of cases	Percentage	Mean age, years (SD)	Percent females (%)
None	1,146	92.4	75 (8.9)	58
Oral midazolam	94	7.6	66 (11.8)	76
1–6 mg				
Total	1,240	100		
P-value			0.0001	0.001

Note: The nine patients who had general anesthesia have been excluded.

Abbreviation: SD, standard deviation.

Surgical complications and other adverse events during surgery

In Table 4, surgical complications and adverse events causing a need for more intraocular manipulations than usual are listed. Nineteen of the 35 cases who had capsular/zonular rupture (1.5%, 19 of the total 1,249) also had vitreous loss.

There was no significant difference in percentage of complications/adverse events between patients who had sedation and those without sedation (6.4% [six of 94] and 7.2% [82 of 1,146], $P=0.94$).

Patient-satisfaction questionnaire

Generally, subjective evaluation of pain during surgery shows very low scores. The median pain score immediately after surgery was 0.7 (quartile 1 [Q1] 0.3–Q3 1.9) ($n=123$, one nonresponder to this question) and decreased to 0.5 (Q1 0.2–Q3 1.15) 6 weeks after surgery ($n=116$, four nonresponders to this question) using the visual analog scale (VAS 0–10).

To analyze if there was any difference between level of pain score and several pre- and perioperative factors, the patients were divided into two groups: patients with a low pain score after surgery (1.9 or less), and patients with a pain score of 2.0 or higher (Table 5).

The group of patients with higher pain scores had pre-medication significantly more often and not surprisingly needed more additional anesthesia. They also would, to a significantly lesser degree, choose the same anesthetic regimen again if having another cataract surgery.

On the day of surgery 119 patients (96%) felt they had just the right amount of anesthetic, and four patients (3%) felt they had too little anesthetic; the answer from one patient (1%) was missing. Hardly surprisingly, the first group reported a median pain score of 0.7 (minimum–maximum [min–max] 0–6.6), and the second group a median pain score of 5.7 (min–max 2.6–8.8).

To evaluate the change in experience (memory) of their surgery, the questionnaire was answered once again 6 weeks postoperatively; 120 patients participated. Almost the same percentage of patients (94% [113 of 120]) said they had had the right amount of anesthetic, six patients (5%) said they had had too little anesthetic, and one patient (1%) answered that there had been too much anesthetic but stated a pain score of 0.4. Median pain score for the first group was 0.45 (min–max 0–7.5) and for the second group the median pain score was 6.6 (min–max 0.4–9.8).

To investigate the consistency in the response that too little anesthetic was given, the questionnaire responses on the day of surgery were compared with the response 6 weeks after surgery for the same patients. Three of the four patients who immediately after surgery felt they had had insufficient anesthetic still had the same feeling 6 weeks later. These three patients had a comparatively high pain score: median 6.5 (min–max 5.0–8.8). However, on the day of surgery, three of these four patients still wanted the same anesthetic method if having cataract surgery again. Six weeks after surgery, only one of these patients would choose the same anesthetic if operated on again, and the two others would like something different, which means that most patients who really experience discomfort and pain during surgery have not forgotten

Table 4 Complications or adverse events causing a need for intraocular manipulations more than usual in relation to sedation and need for additional anesthetics

Type of complication/intraocular manipulation	Number of patients	Percentage of the total number of cases ($n=1,249$)	Need for additional anesthetics, n (%)	Preoperative sedation, n (%)
Capsular/zonular rupture with or without vitreous loss	35	2.8	9 (26)	1 (3)
Dropped nucleus	1	0.1	0	0
Prolapse of the iris	31	2.5	6 (19)	4 (13)
Difficult and prolonged cortical cleanup	15	1.2	2 (13)	0
Iris dilated by hooks	7	0.6	4 (57)	0
Weak zonulae	4	0.3	1 (25)	1 (25)
Total	93	7.5	22 (24)	6 (6)

Note: The percentage of patients with need for additional anesthetics is given for each complication separately.

Table 5 Level of pain score related to several pre- and perioperative factors

	Pain score 1.9 or less (VAS)	Pain score 2.0 or higher (VAS)	P-value
Number of patients	93	30	
Mean pulse rate (SD)	72 (10.7)	71 (10)	0.76
Mean oxygen saturation % (SD)	97.1 (4)	96.7 (2.3)	0.61
Age, years (SD)	74.5 (8.6)	77.2 (8.4)	0.13
Any sedation preoperatively, n (%) (four patients were missing in each group)	3 (3.4)	4 (15.4)	0.045*
Patient needed additional anesthesia, n (%)	2 (2.1)	1 (3.3)	0.012*
Second eye surgery, n (%)	34 (37)	8 (27)	0.44
Females, n (%)	53 (57)	17 (56.7)	0.86
Complications and/or adverse events, n (%)	10 (10.7)	3 (10)	1.0
Will choose the same anesthetics if having cataract surgery again, n (%)	93 (100)	26 (87.7)	0.003*

Note: *Statistically significant ($P < 0.05$).

Abbreviations: VAS, visual analog score; SD, standard deviation.

6 weeks later. Neither of the two patients who on the day of surgery felt they had had a sufficient amount of anesthetic, but 6 weeks later also stated that they had had an insufficient amount of anesthetic, wanted a change in anesthetic method if operated on again.

Discussion

This large series of small-incision PE surgery shows that combined topical and intracameral anesthesia without sedation appears to be efficient and well tolerated for most patients. Ninety percent of the study patients had combined topical and intracameral anesthesia without sedation, and only a few experienced insufficient anesthesia. Supplementary anesthetics were rarely needed, and in the majority of cases additional drops of amethocaine hydrochloride (1%) were sufficient.

The rating of perceived intrasurgical pain immediately after surgery, using the VAS scale (0–10), showed that most patients experienced a very low degree of pain, with a median score of 0.7. Six weeks after surgery, the median pain score was 0.5, indicating that the memory of pain perception during cataract surgery decreases with time. Another indication that our anesthetic regimen functions well is that most patients would choose the same anesthetic if having surgery again, also the majority of patients who stated a pain score 2 or

higher would choose the same anesthetic again. The level of pain score in this study corresponds well with findings in previous studies.^{16–18}

Tan et al¹⁸ found that 70% of their intracameral lidocaine patient group had pain scores of 0–1. Females, non-Chinese, and patients with previous cataract surgery were more likely to experience pain. Difference in pain score by ethnicity was not possible to evaluate in this almost homogeneous Caucasian group, and higher pain scores in females or those having second eye surgery were not found. However, in our study, females and younger patients wanted sedation more frequently, which can explain the difference.

The frequency of complications with vitreous loss was low and similar to Sweden as a whole (1.5% versus 1.3%).³ Therefore, all patients with any type of intraoperative complication and/or adverse event with more intraoperative manipulations than usual were pooled (Table 4). For this small group of patients (7% [93 of 1,249]), a combination of topical and intracameral anesthesia was sufficient in three-quarters of the cases, but 24% (22 of 93) of these patients needed additional anesthetics.

Sunderby Hospital is situated in the sparsely populated far north of Sweden. Many patients need to travel a long way for cataract surgery. The clinic needed a standard anesthetic regimen that maximizes patient cooperation (sedatives only if necessary) and gives an adequate anesthetic effect, and also if more complications/intraocular manipulations than usual should occur, as pseudoexfoliations are common among our patients (40%, personal communication). A high level of patient self-efficacy and confidence with the operating procedures is important.

The goal of our anesthetic regimen is low-risk and adequate pain control. To increase efficiency, there should only be a few cases where the surgeon needs to consider other anesthetic methods. Different methods of anesthesia have been considered, and topical anesthesia only has the limitation of inadequate blocking of sensory nerves from the iris and ciliary body. This causes discomfort, especially during manipulation of the iris and/or intraocular lens implantation. Supplemental intracameral lidocaine significantly decreases the degree to which patients are bothered by tissue manipulation, and therefore patient cooperation increases. It also reduces both the proportion of patients experiencing pain and the degree of pain experienced.^{16,18,19} In the present study, there were no complications caused by the anesthetic method, and in most cases the combination functioned well even if intraoperative complications occurred.

The strength of the present study is that it was prospective, observational, and population-based. All patients having

small-incision PE surgery during a 1-year period at Sunderby Hospital were included, with very few dropouts. Also, the questionnaire had a high participation rate.

A weakness of the study is that the questionnaire only comprised patients operated on during a 1-month period (n=124). It would have been better if all patients during the 1-year period had answered the questionnaire. However, we have no indication that the results presented would have changed if all patients had answered the questionnaire.

Conclusion

A standardized anesthetic method with topical and intracameral anesthetics without sedation seems well tolerated by patients and is effective at surgery, and also in cases when complications/adverse events occur. Patient satisfaction was high, and a majority of patients would choose the same anesthetic method if having surgery again. However, there were a few patients who experienced insufficient anesthesia. It is important to be responsive to individual patient needs and adjust anesthetic procedures when necessary.

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Disclosure

None of the authors has a financial interest in any product mentioned.

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