



What should we not do in phacoemulsification and intraocular lens implantation surgery?

Common pitfalls and surgical errors

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Abstract

Cataract is the most common cause of preventable blindness caused by opacification of the normal crystalline lens of the eye. In the last 20 years, phacoemulsification surgery, which offers the advantage of smaller incisions, has become widespread in cataract surgery. There are preoperative and intraoperative steps that should be taken to increase patient comfort and prevent surgical complications. In our literature review, there is limited data on what should not be done during surgery. This review was prepared to emphasize the mistakes that should be avoided during phacoemulsification surgery.

Keywords

phacoemulsification, intraocular lens (IOL) implantation, cataract surgery, surgical complications, patient preparation

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Introduction

Cataract surgery is one of the most commonly performed surgical procedures in the world.¹ Phacoemulsification surgery is widely preferred due to its low complication rates and rapid postoperative recovery. There are critical mistakes that should not be made in the preoperative and surgical stages of incision, capsulorhexis, hydrodissection, phacoemulsification, irrigation/aspiration, intraocular lens implantation, and wound closure.

Common Mistakes During the Preparation Phase

Failure to Select the Appropriate Patient

Failure to select the appropriate patient is one of the most common mistakes made during the preparation phase of cataract surgery.

The patient's age, head, neck, and posture characteristics and comorbidities affect the type of anesthesia to be selected and your case plan.

General anesthesia is required in pediatric patients and in adults with difficult cooperation.²

Planning surgery under local anesthesia in patients with significant kyphosis, scoliosis, and additional diseases such as Parkinson's disease, causing tremor, may prolong the total duration of surgery and increase the risk of complications.

Local anesthesia may not be a suitable option in patients with respiratory problems such as chronic obstructive pulmonary disease (COPD), heart failure, or panic attacks.

The patient's ocular structure (hollow eye, strabismus, nystagmus, etc.) and biomicroscopic examination (corneal guttata, pseudoexfoliation syndrome, etc.) should be well evaluated preoperatively, as they will be effective in determining the type of anesthesia and planning the surgery.

Each patient's name, surname, and the eye to be operated on should be carefully questioned preoperatively.

Failure to Provide Appropriate Dilatation Preoperatively

Combinations of 3 different types of drugs are used to provide preoperative mydriasis: anticholinergic agents such as tropicamide 1%, cyclopentolate 1%, scopolamine 0.25%, sympathetic agonists such as phenylephrine 2.5% or 10%, and topical non-steroidal anti-inflammatory drug (NSAIDs) such as indomethacin 1%, flurbiprofen 0.03%.³

High doses and frequent instillation of topical drops may cause pupil fatigue, and the desired preoperative dilation may not be achieved.

To ensure appropriate dilation, topical drops should be instilled approximately 1 hour before surgery, and at least 5 minutes should be left between them.

In the preoperative preparation phase, the patient should be asked about the use of systemic medications that will affect pupil dilatation (alpha2 blockers, parasympathomimetics, opiates, etc.).

Errors in Biometry

Precision and accuracy in biometric measurements are extremely important to achieve the desired postoperative refractive results.

The patient's name, surname, identity information, diopters calculated according to A-constat values depending on the brand of the intraocular lens used, keratometry, and axial length measurements should be carefully examined in measurements performed with intraocular lens (IOL) Master and B-scan ultrasonography.

The cornea should not be compressed during measurement with B-scan ultrasonography. An error of 1 mm in axial length measurement with biometric ultrasound leads to a change in IOL

power of 2.5 D in normal eyes and 3.75 diopters in small eyes with axial length <20 mm. If the axial length is >26 mm or <21 mm, keratometry is >47 D or <41 D, astigmatism is more than 2.5 D, axial length difference between the two eyes is more than 0.7, keratometry difference between the two eyes is more than 0.9, B scan USG measurement should be repeated.⁴

Not Choosing the Appropriate Type of Anesthesia

Intraoperative and postoperative pain is one of the main reasons for low patient satisfaction. Choosing the appropriate type of anesthesia for the patient reduces the risk of complications and shortens the total case durations. During phacoemulsification surgery, 6 types of anesthesia can be used: general anesthesia, peribulbar, retrobulbar, subtenon, topical, and intracameral.²

Although it does not cause akinesia in phacoemulsification surgery, topical anesthesia is most commonly used because it is easy to administer and the perceived pain level is low.

Retrobulbar and peribulbar anesthesia can be used in patients with longer surgical duration. Although it has stronger effects than topical anesthesia, it is not frequently preferred in routine practice due to the proximity of the injection site, the risk of retrobulbar hemorrhage, and perceived pain.

Caution should be exercised when performing retrobulbar and peribulbar anesthesia in myopic eyes with high axial length in terms of the risk of intraocular perforation.

Subtenon anesthesia is also not used frequently due to the risk of subconjunctival hemorrhage, chemosis, and scleral perforation.

General anesthesia is recommended for pediatric patients, patients with difficulty in cooperation, and patients allergic to local anesthetics.

Intracameral anesthesia is used as an adjunct to topical anesthesia.

Failure to Provide Appropriate Antiseptics

One of the common mistakes made during preoperative preparation is not providing appropriate antiseptics and not applying appropriate povidone iodine.

Hands should be washed with soapy water or alcohol before each case.

Gloves should be changed after each case or contact with a non-sterile surface.⁵

Sterilization procedures should be repeated before each case, and nurses should be warned about this issue.

All surgical instruments in contact with the eyes should be autoclaved.

An ethylene oxide sterilizer can be used for hoses and plastic instruments. The water to be used for rinsing is again distilled or deionized water.

Intraocular surgical instruments should be wiped with damp lint-free cloths during the operation to prevent drying of the residues on them until they are reused.

Luminal instruments should be sprayed with sterile water or placed in sterile water baths.⁶

Povidone iodine not administered at the appropriate dose and duration during the preparation phase of surgery increases the risk of postoperative endophthalmitis. Application of povidone iodine concentration to the ocular surface at the same concentration as to the periocular surface will cause epithelial damage and edema in the cornea.⁷ Preoperatively, 10% povidone-iodine should be applied to the eyelid and periocular skin, while 5% povidone-iodine solution should be applied to the conjunctiva and cornea, and then wait for a minimum of 3 minutes.

If povidone iodine is contraindicated (allergy, hyperthyroidism, etc.), chlorhexidine aqueous solution (2%) should be used.⁸

The border for staining the periorbital region should be the hairline of the forehead, the tip of the nose, the nasolabial fold, and the ear on the side of the eye to be operated on.⁵

Non-Appropriate Draping

Insufficient drying of the skin after povidone iodine may cause problems in placing the drape on the skin.

Eyelids and eyelashes should not remain outside the drape.

The direction of the incision should be from the inside to the outside, with semicircular movements away from the cornea.

The incision should extend to the lateral canthus and intraocular fluids should drain into the drape pouch.

The drape bag may disrupt the drape position with increasing fluid volume during the case, and the intraoperative image may be distorted. The drape bag should be monitored at the time of the case and replaced before it is full.⁹

Common Mistakes During Surgery

Common Mistakes During the Incision Phase

Every case that starts with a poor incision increases the risk of complications.

The incision site should not be close to the conjunctival vessels but should be 0.5-1.5 mm from the limbus, slightly cutting the limbal vessels.

The main incision site varies depending on the surgeon's technique, but should be temporal, away from the visual axis and brow restriction. Since most cataract patients are elderly, the main incision made in the superior quadrants will cause more astigmatism in accordance with the rule.

An asymmetric incision where the base and roof lips of the incision are not equal will cause poor sealing throughout the case.

A shorter-than-normal tunnel length of the incision will cause poor sealing and high astigmatism, while a longer-than-normal tunnel will cause less astigmatism but difficulty in manipulation.

The width of the incisions should be compatible with the tip of the phaco probe, the I/A tips, and the cartridge injector of the IOL. Narrow incisions (<1.8 mm) have not been shown to reduce postoperative astigmatism, while wider than normal incisions (>3.2 mm) have been shown to cause surge and iris prolapse. The ideal main incision should be between 1.8 and 2.2 mm.

Common Mistakes During the Capsulorhexis Phase

One of the common mistakes during capsulorhexis is not staining the anterior capsule properly with trypan blue. Understaining of the capsule leads to impaired visualization, failure to follow the flap, and failure to recognize radial tears, while overstaining causes the capsule to be more rigid and the rexis to escape easily to the periphery.¹⁰

After the flap is formed during capsulorhexis, the flap should not be pulled in a way that will cause zonular destruction during its advancement.

In the part under the main incision, the flap should be passed in a single pass. Otherwise, manipulation of the utricle will become difficult in the continuation of the flap.

The ideal capsulorhexis size depends on the IOL optical size. A capsular opening of 5.0 to 5.2 mm should be created for optimal 6.0 mm diameter IOL overlap.¹¹ A narrower capsulorhexis will cause intraoperative manipulation difficulty, resulting in fewer postoperative IOL repositions and less postoperative PCO and glare. A wider capsulorhexis will provide ease of intraoperative

manipulation, resulting in more intraoperative and postoperative IOL repositions and more postoperative PCO and glare.¹²

In patients with a history of frequent injections, posterior polar cataracts, mature/hypermature cataracts, or posttraumatic cataracts, careless hydrodissection may cause posterior capsule rupture. In hypermature cataracts with a swollen anterior capsule, careless capsulorhexis may cause anterior capsule perforation (argent flag) in a shallowing anterior chamber with increased posterior chamber pressure. Anterior chamber pressure should always be maintained with viscoelastic, and the anterior chamber should not become shallow at any point during capsulorhexis. Phaco capsulotomy, two-stage continuous curvilinear capsulorhexis (CCC), preoperative/intraoperative depressurization of the posterior intralenticular chamber may also be attempted to prevent the Argentine flag.

Common Mistakes Made During the Phacoemulsification Phase

Failure to open the appropriate groove during the phaco phase may increase the risk of complications and case duration for the rest of the case. The anterior-posterior diameter of the adult lens is 4 mm in the center, while the standard phaco tip is 1 mm. Therefore, when opening the groove, care should be taken to make it 3-4 phaco tip widths in the center and shallower when going to the periphery. If the groove is not symmetrical, it may cause the nucleus to break unevenly, crumble, and break from several different levels.

Another cause of error in the phaco stage is failure to select the appropriate chopper. The chopper is helpful in breaking and fragmenting the nucleus, removing the nucleus from the capsular sac, pushing the fragments to the phaco tip, protecting the posterior capsule, and stabilizing the eye.¹³ Choosing the appropriate chopper for the case and the type of cataract reduces the risk of complications. Regardless of the chopper type, the chopper tip should be visible and away from the posterior capsule throughout the case.

The main incision size should be appropriate due to the risk of phaco tip, surge, and intraoperative floppy iris syndrome (IFIS). In case of IFIS development, high fluid flow on the iris and incisions and manipulations that increase intraocular pressure should be avoided.

Low vacuum and low aspiration values should be used.

The phaco tip should be at an appropriate distance from the capsulorhexis border and the desme membrane during the eating phase. It is extremely important from a medigolegal point of view that the desme membrane is eaten with the phaco tip.

The main incision site should be washed frequently due to the risk of corneal burns in cases where phaco time is planned to be long.

Common Mistakes During the Irrigation/Aspiration Phase

Failure to select the appropriate vacuum values during cortex removal may cause tears in the anterior and posterior capsule or damage to the zonules.

During the polishing phase, I/A should be performed gently because of its proximity to the posterior capsule.

Intraoperative intensive use of viscoelastic may cause postoperative intraocular pressure increase and pain, so the viscoelastic should be removed by entering behind the IOL with the I/A tip.¹⁴

Common Mistakes During IOL Implantation

Anterior and posterior capsule status should be well evaluated before IOL implantation. In the case of intact posterior capsule and zonules, the IOL should be implanted into the bag, whereas in cases where the posterior capsule is not intact but the anterior capsule is intact and the zonules are intact, the IOL should be implanted

into the sulcus.¹⁵

One of the most common problems encountered during IOL implantation is cartridge-related problems. Inappropriate viscoelastic in the cartridge or incompatibility between the main incision and the cartridge tip may cause inappropriate placement of the IOL in the eye. If the IOL gets stuck in the cartridge, the cartridge can be retracted, and a new IOL can be placed, or the IOL can be saved by cutting the cartridge.

If the IOL gets stuck in the main incision, the main incision can be enlarged, and the IOL can be removed from the main incision or the IOL can be cut with the help of Wiskott scissors so that it can be removed from the eye.

After the IOL comes into the eye, the haptics should be placed in an inverted S-shape. If it is understood that the haptics will open in the opposite way, the intraocular lens can be turned 180 degrees to ensure proper haptic placement.

Common Mistakes at the End of the Case

Lack of proper stromal hydration during the wound closure phase leads to poor postoperative sealing.

Failure to administer intracameral antibiotics may cause postoperative endophthalmitis.

Wound sites should be carefully checked for foreign bodies, and the operated eye should be closed appropriately at the end of the case.

Ethical Approval

Ethical approval was not required because this study is a literature review.

Statistical Analysis

Not applicable.

Reporting guidelines

Reporting guidelines were not applicable because this study is a narrative review.

Limitations

This review is based on existing literature, which may not include the most recent advancements in phacoemulsification surgery. Additionally, there is limited research specifically focusing on the mistakes to avoid during surgery, which may lead to gaps in the coverage of potential surgical errors. The recommendations may also vary depending on individual surgical experience and practice, as these can differ across institutions and geographic regions.

Conclusion

Phacoemulsification and intraocular lens implantation surgery require detailed planning and attention in both preoperative preparation and intraoperative and postoperative periods. Mistakes that should not be made at all stages, from patient selection to wound closure, can directly affect surgical success and patient satisfaction. It is important to have more guidance on what not to do to reduce complication rates in the future.

Declarations

Animal and Human Rights Statement

This article does not contain any studies with human participants or animals performed by the authors.

Informed Consent

Not applicable.

Data Availability

No new data were generated or analyzed in this study. All information is derived from previously published studies cited in the references.

Conflict of Interest

The authors declare that there is no conflict of interest.

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The authors declare that no AI-assisted technologies were used.

Abbreviations

CCC: Continuous curvilinear capsulorhexis

COPD: Chronic obstructive pulmonary disease

I/A: Irrigation/aspiration

IFIS: Intraoperative floppy iris syndrome

IOL: Intraocular lens

NSAID: Nonsteroidal anti-inflammatory drug

USG: Ultrasonography

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