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Does surgical technique influence cataract surgery contamination?

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PURPOSE. *To compare cataract surgery contamination rates in large-incision extracapsular cataract extraction (ECCE) and phacoemulsification (PE), we studied 65 cases prospectively.*
METHODS. *Thirty-five cases were operated by large-incision ECCE (Group I) and 30 by PE (Group II). Conjunctival swab cultures were taken immediately before surgery and anterior chamber aspirate was taken for culture upon completion of surgery for each case.*
RESULTS. *Anterior chamber cultures were positive in 22.8% of the cases in group I and 23% in Group II. Frequencies of contamination in each group were no different (x^2: 0.22, $p>0.05$). When the contaminations were evaluated in relation to operating time, prolongation of the operating time raised the contamination rate in Group I ($p<0.05$) but not in Group II ($p>0.05$). Silicone and PMMA intraocular lenses (IOL) were tested to see whether they had any additional risk of contamination. The frequencies of contaminated silicone IOL implanted cases (6/26) and contaminated PMMA IOL implanted cases (8/39) were similar (x^2: 0.36, $p>0.05$).*
CONCLUSIONS. *Although the architecture of the incision and irrigation dynamics provided an advantage to the PE technique as the operating time became longer, routine PE was not superior to classical ECCE with respect to contamination when performed in the same circumstances. Prolonging the operating time raised the contamination rate in classical ECCE. (Eur J Ophthalmol 2001; 11: 31-6)*

KEY WORDS. *Extracapsular cataract extraction, Phacoemulsification, Contamination*

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INTRODUCTION

In spite of substantial developments in cataract surgery in recent years, intraoperative anterior chamber contamination rates still reach 3.9-43% (1-6). Microorganisms from the periocular microflora which enter the anterior chamber during surgical manipulations are the cause of endophthalmitis (7). The incidence of endophthalmitis ranges between zero and 0.24% in the literature (8-11). This study, compared two surgical techniques to check their anterior chamber contamination rates, to see if phacoemulsification (PE) performed through a small incision, under a closed system, was superior to the classical large-incision extracapsular cataract extraction (ECCE).

PATIENTS AND METHODS

A total of 65 cases having the following inclusion criteria were investigated for the anterior chamber contamination rates during cataract surgery:

1) patients undergoing cataract extraction and intraocular lens (IOL) implantation;

2) no history of ocular trauma or surgery;

3) no past or present infectious or inflammatory eye disease;

4) no intraoperative complications like posterior capsule rupture or vitreous loss which are predisposing risk factors for endophthalmitis (12, 13).

Cataract extraction was performed using ECCE with a large incision (10-13 mm) in the first group (35 cas-

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es) and phacoemulsification with a small incision (3 to 6-5 mm) in the second (30 cases). The mean age of the first group was 63.8 (± 6.21) years and 58.20 (± 3.25) years for the second. Large-incision ECCE was scheduled in 18 cases who were not good candidates for continuous circular capsularrhexis (CCC) because of inadequate fundus light reflexes as a result of completely opalescent lenses or/and inadequate pupil dilatation. Other cases were randomly allocated to either group.

All patients were admitted to the Ondokuz Mayis University Faculty of Medicine Hospital the day before surgery. The eyes were dilated with 10% cyclopentolate and 10% phenylephrine drops on the day of surgery. Each patient had also received ibuprofen drops four times, instilled every 30 minutes, starting 2 hours before surgery. Patients operated under local anesthesia also had topical anesthetic drops several times.

Periocular antisepsis was achieved with 5% povidone-iodine solution. Initially two drops of povidone-iodine were instilled onto the cornea and then the eyelids, nose, cheeks, eyebrow and forehead were scrubbed three times in concentric circles extending outward from the eyelashes, waiting 1 minute after each scrub. Finally, the povidone-iodine was wiped off with a sterile sponge in a similar concentric pattern. The head was draped with sterile cloths. Eyelids and eye lashes were covered and retracted from the operative field with plastic self-adhesive drape. A central opening was made on the drape to expose the globe and a wire speculum was placed to expose it better. All the exposed ocular surfaces were washed with balanced salt solution, then a culture swab was drawn across the inferior fornix and immediately immersed in thioglycolate broth.

Thirty-five cases had the cataract extracted by nuclear expression through a limbal two-stepped incision, changing the width from 10 to 13 mm, and 30 cases had a 3.2 mm corneal or scleral tunnel incision by the bimanual phacoemulsification technique. A second hand incision was placed 30° to the nasal or temporal side of the primary incisions in phaco cases.

Sulcus or capsular fixated monobloc polymethymethacrylate intraocular lenses (PMMA IOL) were implanted in all the first group and in the four of the phaco cases, after widening the original incision to 6 mm; 26 of the phaco group had plate haptic silicone lenses injected into the capsular bag using a Chiron Intraoptics lens injector. After IOL implantation and re-

TABLE I - PATIENTS' MAIN SURGICAL DATA

Surgical methods		**Patient**	
		No.	**(%)**
Surgical technique	PE	30	46
	ECCE	35	54
Wound width	3 mm	26	40
	5-6 mm*	4	6
	10-13 mm	35	54
Wound type	Corneal tunnel	23	35
	Scleral tunnel	7	11
	Limbal	35	54
Wound closure	No stitch	24	36.9
	Single stitch	2	3
	Double stitches	4	6.15
	Running stitches	35	54
IOL type	Silicone **	26	40
	All PMMA	39	60

PE: phacoemulsification, ECCE: extra capsular cataract extraction, IOL: intraocular lens, PMMA: polymethyl methacrylate, *: incision enlarged to accommodate PMMA IOL after PE, **: plate haptic model

moval of the viscoelastic substance, myosis was achieved with intraocular acetylcholine. Wide incisions from 10-13 mm were closed by running stitches and three planar tunnel incisions from 3.2-6 mm were sutured by single stitches or double if single ones did not prove watertight. At this stage 0.05-0.2 ml anterior chamber fluid was aspirated using a 27-gauge cannula attached to a tubeculin syringe. The anterior chamber was reformed with an infusion of balanced salt solution. Gentamicin 40 mg and betamethasone 3 mg were injected subconjunctivally at the conclusion of every operation.

Operations were done by seven different surgeons and the operating time for each case was recorded. The patients' main surgical data are given in Table I.

Aspirated fluid was inoculated onto a blood agar plate immediately after surgery and the blood plates and thioglycolate broth tubes were trasported to the microbiology laboratory in the same hospital, where they were incubated at 37 °C in 5% carbon dioxide for maximum ten days. Microorganisms growing in the thioglycolate broth were reinoculated onto eosine methyl blue (EMB) and blood agar plates. No growth was detected on the EMB agar plates. Bacterial isolates were identified according to their colony morphology, Gram staining properties, catalase and coagulase test responses, and results were expressed as colony forming units (CFU/ml) on the basis of colony counts in the agar plate.

The growth frequencies in both groups were compared by chi-squared analysis and the average operating times for contaminated and sterile cases in both groups were calculated and compared to see if these influenced the contamination rate. The monobloc sili-

TABLE II - PATIENTS WITH POSITIVE CULTURES

Patient No.	Surgical technique	Positive culture	Organism	Colony forming units/ml	Interval to growth (days)
1	ECCE	Thiogly. broth	*S. aureus*	–	2
		Blood agar	*S. aureus*	200	2
2	ECCE	Blood agar	*S. epidermidis*	100	2
3	ECCE	Blood agar	*S. epidermidis*	20	2
4	ECCE	Blood agar	*Diphtheroids*	120	6
5	ECCE	Blood agar	*Diphtheroids*	100	2
6	ECCE	Blood agar	*Micrococcus*	10	3
7	ECCE	Blood agar	*Micrococcus*	10	7
8	ECCE	Blood agar	*S. capitis*	30	3
9	ECCE	Thiogly. broth	*S. epidermidis*	–	8
10	ECCE	Thiogly. broth	*S. epidermidis*	–	3
11	ECCE	Thiogly. broth	*S. epidermidis*	–	6
12	ECCE	Thiogly. broth	*S. epidermidis*	–	3
13	PE	Blood agar	*S. epidermidis*	20	3
14	PE	Blood agar	*S. epidermidis*	20	2
15	PE	Blood agar	*S. epidermidis*	5	2
		Thiogly. broth	*S. epidermidis*	–	4
16	PE	Blood agar	*S. epidermidis*	100	2
17	PE	Blood agar	*Micrococcus*	10	5
18	PE	Blood agar	*Micrococcus*	5	3
19	PE	Blood agar	*S. capitis*	150	3
20	PE	Thiogly. broth	*S. xylosus*	–	6
21	PE	Thiogly. broth	*S. aureus*	–	6
22	PE	Thiogly. broth	*S. hominis*	–	8

ECCE: Extracapsular cataract extraction, PE: Phacoemulsification

cone and monobloc PMMA lenses implanted in this study were also compared to see if they involved any additional risk of contamination.

Follow-up ranged from 4 to 8 months after surgery. Topical prednisolone acetate 1% drops were prescribed four times daily for the first week and twice daily for two to four weeks after surgery.

RESULTS

Five of the conjunctival swab cultures (14%) and eight of the anterior chamber fluid cultures (22.8%) in Group I and four conjunctival cultures (13%) and seven anterior chamber cultures (23%) in Group II were positive. There was no significant difference between the groups with respect to anterior chamber fluid cultures ($x^2 = 0.22$, $p>0.05$). Growths were detected between the second and eighth days. Quantitative analysis of each microorganism recovered extrapolated to a range of 5-200 CFU/ml (Tab. II). In Group I for the conjunctival swabs four of the isolates were identified as *Staph. epidermidis* and the fifth was *Staph. aureus*; in Group II one of each of the following was isolated; coagulase(+) *Staph. aureus*, coagulase (-) *Staph. epidermidis, Staph. hominis, Staph. xylosis*. The anterior chamber aspirate cultures gave *Staph. epidermidis* (2), Diphtheroids (2), *Micrococcus roseus* (2), *Staph. aureus* (1) and *Staph. capitis* (1) in Group I.

In Group II *Staph. epidermidis* was the most frequent isolate, with four cases, *Micrococcus roseus* (2), and *Staph. capitis* (1) being the remaining isolates. In one instance in each group the same microorganism was cultured simultaneously from the conjunctive and anterior chamber of the same patient. In other cases either the conjunctiva or anterior chamber culture was positive only.

A Pharmacia 720C IOL (6.5 mm) was implanted in seven of the contaminated cases in Group I and Ophtec 281Y (5x6 mm) IOL in one. Plate haptic silicone IOL were implanted in all the contaminated cases in Group II. The contaminated PE cases had self-sealing corneal tunnel incisions except for one which had double stitches after a scleral tunnel incision.

No case having a total operating time 15 minutes or less was contaminated, but cases with total operating time 45 minutes or more were all contaminated in both groups. Mean operating times in contaminated and sterile cases were 43.7 (±14.23) and 26.9 (±9.9) min in Group I, and 27.5 (±7.5) and 26 (±7.06) min in Group II. Statistical analysis indicated that the mean operating time of the contaminated cases was significantly longer in Group I ($p<0.05$) but there was no difference in Group II ($p>0.05$). When the contaminated cases were classified according to the IOL biomaterial seven of the 26 silicone IOL and eight of the 39 PMMA IOL implanted cases were contaminated. Chi-square analysis indicated that the frequency of anterior chamber contamination was independent of the IOL biomaterial ($x^2 = 0.36$, $p>0.05$).

No patient developed endophathalmitis or any anterior chamber inflammation resistant to the existing therapeutic approaches in the follow-up period.

DISCUSSION

The anterior chamber can become contaminated during cataract surgery to different extents in different ways. Sherwood et al (4) demonstrated the flow of flourescein-stained ocular surface fluid into the anterior chamber during the aspiration stage of ECCE and during IOL implantation. They claimed this fluid, which might be contaminated by microbial flora from the ocular surfaces, was likely to be the source of some postoperative endophthalmitis. Vafidis et al (14), however, demonstrated the potential role of IOL in the anterior chamber contamination. They found 26% of the lenses were contaminated after 5 seconds contact with the conjunctiva, 15% were contaminated just after exposure to the operating theater air, this being significantly more than simultaneously taken cinjunctival swabs (6%) or irrigation specimens (8%). This difference was attributed to electrostatic charges that accumulated on PMMA, increasing its affinity for bacteria from the ocular surface. Besides many factors like surgical instruments, fluids, viscoelastics, medications that have access to the anterior chamber, preoperative prophylactic antibiotic drops, current surgical techniques and the environment where the surgery is done, may all be responsible in the surgical contamination (5).

Sherwood et al (4) found 29% contamination with the traditional large-incision nuclear expression tech-

nique. Walters et al (2) found 4% and 5% contamination rates with the same surgical technique but different presurgical preparations. With PE Assia et al (1) found 3.9% and Samad et al (3) found 5% contamination. In other studies including cases operated by PE, classical ECCE or mini-nuc techniques 32.5% (5) and 43% (6) contamination rates were reported. Tervo et al (51) cultured samples from the lid margin, lacrimal lake conjunctiva and anterior chamber; they found more positive cases (59.2%) than we did (13.5%). The difference might be explained by the preoperative preparation since they used 80% alcohol and we used beta-iodine for periocular antisepsis. On the other hand they only had 8% growth and we had 23% from anterior chamber fluid cultures. Their low growth rate may be attributed to the smaller amount of fluid (10-20 µ) used for inoculation in their study than in ours (50-200 µ).

We found no advantage of PE over classical ECCE as regards contamination rates ($p>0.05$). However, prolongation of the operative time increased the contamination rate in ECCE but not in PE. Samad et al (3) also found the contamination rate was not related to the operating time with PE. We could not actually prove the source of the microorganisms contaminating the anterior chamber but we thought surgical instruments might be responsible for most of the contaminations in PE. The huge phaco probe with the surrounding silicon sleeve had close contact with the ocular surface during entrance into the tight tunnel incision. Contacts between surgical instruments, IOL and the ocular surface might permit microorganisms to attach to them by electrostatic, Van der Vals and hydrophobic interactions, and thus enable the organism to enter the anterior chamber (14, 16, 17).

It has been claimed that adsorbtion of the microorganism onto IOL could be prevented by washing it before implantation. A similar approach may prevent microorganisms attaching themselves to other surgical instruments. Microorganisms on the phaco probe can be released into the anterior chamber when it vibrates, but microorganisms on static surfaces like the IOL form adhesions in a few hours by producing a polysaccharide biofilm (17-19).

Microorganisms have different affinity for different biomaterials. Elsa et al (16, 17) showed *Staph. epidermidis* had twice the affinity to polypropylene than PMMA haptic material *in vitro* and the incidence of endophthalmitis in polypropylene haptic IOL was double that with PMMA IOL *in vivo*. Microorganisms also had great affinity for silicone lenses when hydrogel, silicone and PMMA lenses were incubated with coagulase (-) *Staph.* cultures (20). In our study silicone lenses were not found to be more risky as regards contamination.

To prevent the development of endophthalmitis after cataract surgery approaches such as application of topical antibiotics, irrigation of the ocular surface with povidone-iodine, adding antibiotics to the irrigation solutions or injecting them directly into the anterior chamber or into the capsular bag have already been used (2, 8, 11, 21, 22).

Microorganisms were recovered from the conjunctival swabs in 13% of our patients disinfected with povidone-iodine. This scrub reduced the number of microorganisms on the conjunctiva and was especially active against Gram(-) organisms (2, 11). Our study confirmed this, since we had no gram(-) growth in conjunctival swab or anterior chamber cultures. Like in other studies, *Staph. epidermidis* was the most frequent casual agent of post-cataract surgery endophthalmitis (1, 3, 5, 6, 13). Although microorganisms were recovered from the anterior chamber of 23% of all eyes in our study, no eyes developed endophthalmitis or any treatment-resistant inflammation. The anterior chamber is able to clear bacteria to some extent by its own defence mechanisms, such as circulating immunoglobulins, complement or by simple filtration through the trabecular meshwork (23, 24). On the other hand animal studies have shown the importance of the inoculum size and virulence of the organism and preservation of the posterior capsule in the development of endophthalmitis (25, 26).

Inoculum sizes in our study were quite small compared to those needed to induce endophthalmitis in animals with an intact posterior capsule. When the inoculum size exceeds the host defense mechanisms ability to cope, endophthalmitis can be expected. PE can be expected to have a lower incidence of surgical contamination and postoperative endophthalmitis, since it is done through a small incision, under a closed system. Our findings indicate, however, that the small incision alone does not reduce contamination, and surgical techniques, antisepsis of the surgical area and operating theater air must also be improved.

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