Bacterial Contamination of Anterior Chamber Fluid Following Non-complicated Cataract Surgery

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OBJECTIVE: To study the anterior chamber contamination during non-complicated cataract surgery and its relationship with normal conjuctival organisms. SETTING: Ophthalmology Department, La Fe Hospital, University of Valencia. PATIENTS: Forty patients who had undergone cataract extraction using either ECCE, phacoemulsification or nucleus fracture methods. RESULTS: Positive cultures of aqueous humour were obtained in 32.5% of cases. The most commonly isolated organism was *Staphylococcus* coagulase-negative. Only in 7.7% of cases was the microorganism found in the conjunctiva the same as that found in the anterior chamber. The inoculum size ranged between 20 and 160 colonies/ml. One of the cases studied developed endophthalmitis 36 hours after surgery. CONCLUSIONS: The conjunctiva could not be the main source of anterior chamber contamination during surgery, although it would be capable of contributing a small number of inocula of organisms without causing any complications.

Keywords: Anterior chamber cultures; Extracapsular extraction; Intraocular lens; Antiobiotic prophylaxis; Endophthalmitis

INTRODUCTION

Many studies have suggested that organisms of common conjunctival and skin flora could be the main source of endophthalmitis after cataract surgery [1–3]. Bacteria and fungi can gain entrance into surgical wounds from instruments, irrigations or from the surgeon himself during the surgical procedure [4]. This fact has recently been reported by Sherwood [5] and Dickey [6] who found, respectively, a 29% and 44% contamination rate of the anterior chamber after cataract surgery.

In this study we have sought to identify and quantify organisms in the anterior chamber fluid in 40 cases of non-complicated cataract extraction (ECCE, phacoemulsification and nucleus fracture) and posterior chamber IOL implantation.

MATERIAL AND METHODS

Three different types of antibiotic prophylaxis (gramicidin, polymyxin-neomycin; chloramphenicol; gentamicin) were used every 4 hours the day prior to operating. They were chosen randomly without any selection criteria. The eyes were dilated with 10% phenilefrine, 1% cyclopentolate, tropicamide and indomethacin every 15 min from 1 hour before surgery. All medications used were sterile.

Twenty patients underwent surgery with local anaesthesia; and the other 20 with general anaesthesia. The surrounding skin was sterilized with 10% povidone-iodine. The head was draped with a sterile cloth and a self-adhesive plastic cover was placed over the surgical field paying careful attention to cover the eyelashes with the plastic. A conjunctival smear was taken before surgery.

The operations were performed by six different surgeons and surgical procedure took between 25 and 60 min. An ECCE and posterior chamber IOL implantation were carried out in 33 cases (using a limbal incision in 20 of them); phacoemulsification in four cases; and nucleus fracture in three cases. The IOL type used in all of the cases was stylepiece PMMA. Apart from surgical instruments, sterile saline solution, viscoelastic material and acetylcholine were also used during surgery.

At the end of the operation, before final suture placement, a sterile 27-gauge cannula attached to

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an insulin syringe was placed into the anterior chamber through the surgical wound. Fluid (0.1 to 0.2 ml) was then aspirated from the anterior chamber. The samples thus extracted were transported immediately from the operating room to the microbiology laboratory. Of the fluid aspirated, 0.05 ml was inoculated onto a chocolate agar plate, and the balance in a thioglycolate broth tube. Cultures were incubated at 37°C with 5% carbon dioxide, and kept for 2 weeks to allow fungus and anaerobe growth. The chocolate agar allowed quantification of organisms into colony-forming units, whereas the broth allowed only qualitative organism identification. Cultures were considered positive only if organisms grew in the central areas of the agar plate.

RESULTS

The conjunctival smears taken before surgery were positive in 37.5% of cases (15/40); 38.5% of patients treated previously with chloramphenicol had positive cultures as did 43.8% treated with gramicidin, polymyxin-neomycin. Of the patients treated previously with gentamicin, 40% had positive cultures. The most commonly isolated organism was *Staphylococcus* coagulase-negative in 86.6% of cases (13/15). One sample of *Streptococcus viridans*, and one of *Corynebacterium* sp. were isolated.

Aqueous humour contamination occurred in 32.5% of cases (13/40). *Staphylococcus epidermidis* was found 46.1% (6/13), *Staphylococcus hominis* in 15.3% (2/13), and *Propionibacterium acnes* in 15.3% (2/13). One sample of each of *Staphylococcus warneri*, *Streptococcus viridans* and *Corynebacterium* sp. were also found. Of the 13 microorganisms isolated, 10 grew on the agar plate and in three cases growth was demonstrated in the thioglycolate.

In those cases in which there was growth of organisms on the agar plate, a quantitative study was performed. The inoculum size was quite small, ranging between 20 and 140 colony-forming units/ml and with a mean of 58 (Fig. 1). In three cases (1, 17 and 24; see Table 1) two different organisms were also added. Of the 13 cases with contamination in the aqueous humour, there was only one in which the organism isolated was the same as in the prior conjunctival smear (7.7%).

DISCUSSION

Our findings of contamination accord with those of other authors. Sherwood [5] found contamination of the anterior chamber in 29% of cases (29/101). In a study of 30 patients (22 of whom underwent extracapsular cataract extraction and eight phacoemulsification) Dickey [6] found contamination in 43% of cases. Ariyasu [7] encountered contamination in 29% of patients who underwent cataract and filtering surgery.

Our study includes cases performed by six different surgeons and using three different surgical techniques: ECCE, phacoemulsification and nucleus fracture.

The organisms isolated in the anterior chamber could have gained entrance during surgery via the

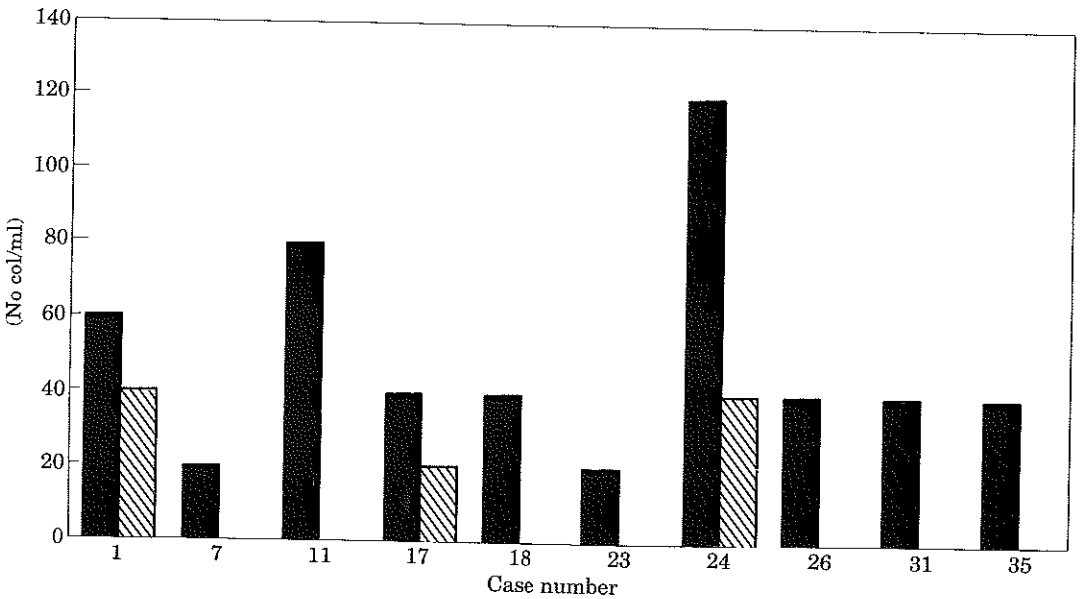

Fig. 1 Inoculum size in those cases in which there was growth of organisms on the agar plate. In three cases (1, 7 and 24, see Table 1) two different types of colonies were found in the same anterior chamber aspirate

Table 1 Culture results

								Cultures		
No.	*Prph*	*A*	*S*	*Tech*	*LC*	*Conjunctival smear*	*Aqueous humour*	TG	Ch	Col./ml
1	Clph	L	ADS	ECCE	–	–	*Corynebacterium* sp.	+	+	60 + 40
2	Clph	L	ADS	ECCE	–	*Staph. epidermidis*	–	+	–	
3	Clph	L	MDL	ECCEL	–	–	*Propionybacteria acnes*	+	–	
4	NGPx	L	ADS	ECCEL	–	–	–	–	–	
5	Clph	L	ADS	ECCE	–	*Staph. epidermidis*	–	–	–	
6	NGPx	L	ADS	ECCE	–	*Staph. epidermidis*	*Strep. viridans*	+	–	
7	NGPx	L	ADS	ECCE	–	–	*Staph. epidermidis*	–	+	20
8	NGPx	L	ADS	ECCE	–	*Staph. epidermidis*	–	–	–	
9	NGPx	L	ANT	ECCE	–	*Staph. epidermidis*	–	–	–	
10	NGPx	L	ADS	ECCEL	–	*Staph. epidermidis*	–	–	–	
11	NGPx	L	ADS	ECCEL	–	–	*Staph. epidermidis*	–	+	80
12	NGPx	L	ADS	ECCEL	–	–	–	–	–	
13	NGPx	L	ADS	ECCEL	–	–	–	–	–	
14	NGPx	L	ADS	ECCEL	–	*Strep. viridans*	–	–	–	
15	NGPx	L	ADS	ECCEL	–	*Staph. epidermidis*	–	–	–	
16	NGPx	L	ADS	ECCEL	–	–	–	–	–	
17	NGPx	L	MDL	ECCEL	–	–	*Staph. epidermidis*	–	+	40 + 20
18	NGPx	L	ADS	ECCEL	–	*Staph. epidermidis*	*Staph. epidermidis*	–	+	40
19	NGPx	L	ADS	ECCEL	–	–	–	–	–	
20	NGPx	L	ADS	ECCEL	–	*Staph. epidermidis*	–	–	–	
21	NGPx	G	ADS	ECCEL	–	*Staph. epidermidis*	–	–	–	
22	NGPx	G	ADS	ECCEL	–	–	–	–	–	
23	Clph	G	JLM	ECCEL	–	–	*Staph. epidermidis*	–	+	20
24	Clph	G	JLM	Phaco	+	–	*Staph. epidermidis*	–	+	40 + 120
25	Clph	G	JLM	Phaco	–	–	–	–	–	
26	Gent	G	JLM	ECCE	+	*Staph. epidermidis*	*Staph. warneri*	–	+	40
27	Clph	G	JLM	N-Fra	–	*Staph. epidermidis*	–	–	–	
28	Gent	G	JTE	ECCE	–	–	–	–	–	
29	Clph	G	JLM	N-Fra	–	*Staph. epidermidis*	–	–	–	
30	Gent	G	ALC	ECCE	+	*Staph. epidermidis*	–	–	–	
31	Gent	G	JLM	Phaco	–	–	*Staph. hominis*	–	+	40
32	Gent	G	JLM	Phaco	–	–	–	–	–	
33	Clph	G	JTE	ECCE	–	–	–	–	–	
34	Clph	G	JLM	N-Fra	+	–	*Propionibacterium* sp.	+	–	
35	Clph	G	ALC	ECCE	+	*Corynebacter* sp.	*Staph. hominis*	–	+	40
36	Clph	G	ADS	ECCEL	–	*Staph. hominis*	–	–	–	
37	Clph	G	ALC	ECCE	–	–	–	–	–	
38	Gent	G	ADS	ECCEL	–	–	–	–	–	
39	Gent	G	JLM	ECCEL	–	–	–	–	–	
40	NGPx	G	JLM	ECCEL	–	–	–	–	–	

Prph, antibiotic prophylaxis; Clph, chloramphenicol; NGPx, neomycin-gramicidin-polymyxin; Gent, gentamicin; A, anaesthesia; L, local; G, general; S, surgeon; Tech, surgical technique; ECCE, extracapsular cataract extraction; ECCEL, extracapsular cataract extraction with limbar incision; Phaco, phacoemulsification; N-Fra, nucleus fracture; LC, lens contact with ocular surface; TG, thioglycolate; Ch, chocolate agar; Staph, *Staphylococcus*; Strep, *Streptococcus*.

surgical instruments, from the ocular surface or eyelashes if they were not well covered [4], by contamination of irrigation fluids or from the surgeon himself.

The IOL itself can play an important role by introducing organisms; there are studies which demonstrate that simple contact of the IOL with the ocular surface before being implanted can be enough to contaminate 30% of the implants due to adherence of microorganisms [8]. In our study of five cases in which the IOL contacted the ocular surface, four had anterior chamber contamination. This adherence can arise as a result of electrostatic forces and reversible hydrophobic unions, and can be avoided by washing the IOL with sterile saline solution prior to implantation. Another cause is attachment of the microorganism glycocalyx to the lens surface [9] which occurs more frequently with lenses made of polypropylene than with those made of polymethylmethacrilate (PMMA) and polyhydroxymethylmethacrilate (PHEMA), particularly in the haptic zone [10]. In all our cases the lens material used was PMMA.

The three types of antibiotic prophylaxis used in our study (gramicidin, polymyxin-neomycin) chloramphenicol; gentamicin) were different from that used by Dickey [6], who used gentamicin the previous day, combined with 5% povidone-iodine at the moment of surgery. This last prophylaxis has been pointed out by Isenberg [11] as being the most effective combination to achieve sterile conjunctiva (99% negative on conjunctival smear). With the different types of prophylaxis used in our study, we obtained a negative conjunctival smear in 62.5% of cases, a

result which accords with the findings of other authors [12, 13].

The most commonly isolated organism (69.2%) was *Staphylococcus* coagulase-negative. In our study, conjunctival and aqueous humour cultures correlated in 14 cases, being negative in 13 of each sample. In only one of the cases in which there was growth within the anterior chamber was the isolated organism the same as in the previous conjunctival smear (7.7%, 1/13). This led us to think that perhaps the source of these organisms could not only be the common conjunctival flora, but the instruments and irrigation systems as well. In his study, Sherwood [5] has found that 90% of the organisms isolated come from the conjunctival flora. The entry of organisms into the anterior chamber could be explained by the mechanical drag of the instruments or by negative pressure created in the anterior chamber at the moment of nucleus extraction or during aspiration of lens material. In our study we used a continuous infusion system with Charleux's cannula which avoids negative pressure into the anterior chamber when aspirating lens material. Ariyasu [7] has also found that 66% of organisms found within the anterior chamber are the same as those which appear in the external ocular flora. His research includes cases of filtering surgery which supposes a greater conjunctival manipulation which may ease the entry of organisms.

One of the cases in our study (number 29) developed endophthalmitis within 39 hours of surgery, and causal organisms could be found neither in the conjunctiva nor in the aqueous humour. It was diagnosed as aseptic endophthalmitis or plastic uveitis.

Despite this contamination of the anterior chamber after surgery, endophthalmitis is a rare complication (0.3% in our hospital [14]). This fact could be explained by the inoculum size (20–140 colonies/ml compared with 10–20 colonies/ml in other studies [6]) and in the ability of the anterior chamber to cope with these organisms. Regarding inoculum size, several experimental studies have demonstrated that an inoculum of more than 10 000 colonies of *Staphylococcus aureus* within the anterior chamber is required to cause endophthalmitis in primates when the posterior capsule is intact [15], and more than 1000 in rabbit eyes after non-complicated extracapsular surgery [16].

With regard to the ability of the anterior chamber of clear up small quantities of organisms, several studies have pointed out the antimicrobial properties of the aqueous humour, with the presence of immunoglobulins [17] and complement factors [18], as well as a possible mechanical filtration of bacteria through the trabeculum. Inoculum infective capacity in the anterior chamber can be explained by colonization density in external tissues and greater size of inoculum [3], higher virulence of the inoculated organisms, systemic disease that may decrease the immunologic response of the patient (e.g. diabetes mellitus, chronic kidney problems) or surgical complications.

Common conjunctival flora maintain the balance of bacterial populations by producing substances toxic to other bacteria. *Staphylococcus epidermidis* is the main organism responsible for keeping this balance [19] and an alteration of it or the presence of methicilin-resistant *Staphylococcus epidermidis* could contribute to the development of endophthalmitis.

Experimental studies [16] on surgical complications have shown that when capsules rupture, fewer numbers of colonies [14] are required to develop endophthalmitis. Organisms can gain entry to the vitreous cavity which seems to have less facility than the anterior chamber to clear up microorganisms [20, 21]. As a result, anterior chamber cultures can be negative in cases of endophthalmitis in which vitreous cultures are positive.

SUMMARY

In order to study anterior chamber contamination during non-complicated cataract surgery and its relationship with normal conjunctival organisms, we report 40 cases in which we have cultured a previous sample harvested from conjunctiva and anterior chamber fluid aspirates at the end of cataract extraction (ECCE, phacoemulsification or nucleus fracture) and posterior chamber IOL implantation. We have obtained positive cultures in aqueous humour in 32.5% of cases. The most commonly isolated organisms was *Staphylococcus* coagulase-negative. Only in 7.7% of cases was the microorganism in conjunctiva the same as the one found in the anterior chamber. The inoculum size ranged between 20 and 160 colonies/ml. One of the cases studied developed endophthalmitis 36 hours after surgery. We suggest that it is unlikely that the conjunctiva are the main source of anterior chamber contamination during surgery and that the latter would be capable of clearing up small size inocula of organisms with no complications.

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