

Intraocular lens implants and risk of endophthalmitis

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Abstract

Aim—To investigate the possible association between the use of three piece foldable silicone polypropylene (SPP) intraocular lenses (IOLs) and an increased risk of postoperative endophthalmitis.

Methods—A retrospective analysis was conducted of all cases of postoperative endophthalmitis following phacoemulsification surgery in a single unit over a 3 year period. The incidence of postoperative endophthalmitis in eyes with SPP IOLs was compared with the incidence in eyes with single piece polymethylmethacrylate (PMMA) IOLs.

Results—772 cataract extractions by phacoemulsification were performed. One (0.16%) of the 622 patients with PMMA IOLs developed endophthalmitis. Excluding one patient who had aplastic anaemia, five (3.33%) of 150 patients with SPP IOLs developed endophthalmitis. The relative risk for postoperative endophthalmitis associated with the use of the SPP IOL compared with the PMMA IOL was 20.1 ($p=0.015$).

Conclusion—This study adds further evidence to the concept that SPP IOLs can be a significant risk factor in the development of postoperative endophthalmitis.

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Postoperative endophthalmitis remains a serious sight threatening complication of cataract surgery. Despite improved antiseptic and antimicrobial prophylaxis the incidence of endophthalmitis following cataract surgery is quoted as 0.08%–0.12%.¹⁻⁵ In many cases the organisms involved are thought to originate from periocular flora.⁶ These organisms may gain entry to the eye by means of surgical instruments, the irrigation fluid,⁷ or by contamination of the intraocular lens implant itself.⁸ Adherence of bacteria to IOLs results from electrostatic charges and is enhanced by the formation of polysaccharide biofilms. The propensity of bacteria to adhere to IOLs may vary according to the lens material. A previous report has suggested an association between the use of an intraocular lens with haptics made of polypropylene and an increased risk of postoperative endophthalmitis.⁹ This study compared the incidence of postoperative endophthalmitis in eyes with silicone-polypropylene (SPP) and single piece polymethylmethacrylate (PMMA) intraocular lens implants (IOLs).

Materials and methods

A retrospective study was conducted to identify the incidence of endophthalmitis following cataract surgery at our unit during a 3 year period by means of a systematic review of operating theatre records and patient case notes. Data on age, sex, type of procedure (conventional extracapsular cataract extraction or phacoemulsification), and IOL type were collected for all patients undergoing cataract surgery during the study period. The diagnosis of endophthalmitis was made clinically, on the basis of symptoms of pain and redness associated with hypopyon and cellular infiltrate of the vitreous, and was confirmed by positive microbiological cultures following aqueous tap or vitreous biopsy. The relative risk of postoperative endophthalmitis associated with the use of a SPP IOL compared with a PMMA IOL was calculated. Fisher's exact test (EPI-INFO Version 6, USD Inc, Stone Mountain, GA, USA) was used to establish the significance of the findings.

Results

A total of 772 patients underwent cataract surgery by phacoemulsification with intraocular lens implant during the study period. There were 470 (61%) females and 302 (39%) males with an age range of 12–101 years and a mean age of 73.4 years (females 75, males 71). There was no significant difference in mean age ($p=0.74$) or male:female ratio ($p=0.31$) between the PMMA and SPP IOL groups. Seven cases of postoperative endophthalmitis were identified (Table 1) with an overall incidence of 0.91%. In five cases the diagnosis was confirmed by microbiological cultures. In the two culture negative cases the diagnoses were made clinically on the basis of symptoms of pain and redness associated with hypopyon and cellular infiltrate of the vitreous.

Before surgery, one patient had a history of mild dry eye syndrome but the remaining patients had no pre-existing abnormalities of the operated eye. One patient had aplastic anaemia, one had a history of chronic alcohol dependence, and another patient had undergone aortic valve replacement 9 months previously. The procedures were performed by a total of four surgeons and no one surgeon was involved in more than three of the seven cases. All cases underwent uncomplicated phacoemulsification with implantation of the intraocular lens into the capsular bag. The six eyes which received folding SPP IOLs (Allergan S13ONB) had 3.2 mm clear corneal stab incisions (superiorly in four cases and temporally in two) extended to 3.5 mm for insertion of the IOL and sutured

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Table 1 Patients with postoperative endophthalmitis

Patient	Age/ sex	Medical history	Ophthalmic history	Preop VA	Surgeon	IOL	Preop prophylaxis	Postop prophylaxis	Time to presentation	Worst VA	RAPD	AC tap	Vitreous tap	Organism	IOL explantation	Final VA
1	68/F	Asthma	—	6/12	A	PMMA	Oc Chlor	Maxitrol*	7 Days	HM	No	No	Yes	Coag neg staph	No	6/6
2	72/M	Aortic valve replacement	—	6/18	B	SPP	s/c Gent/Bet	Maxitrol	7 Days	HM	No	Yes	No	No growth	No	6/18
3	72/F	Colectomy	Dry eyes	6/9	A	SPP	s/c Gent/Bet	Maxitrol	10 Days	CF	No	No	No	NA	No	6/6
4	66/M	Alcohol dependence, osteoporosis	Fellow RD	6/36	C	SPP	s/c Gent/Bet, iv Cef	Maxitrol	10 Days	CF	No	No	Yes	Coag neg staph	Yes	6/9
5	75/M	COAD, diverticular disease	—	CF	C	SPP	s/c Bet	Maxitrol	4 Days	6/36	No	Yes	Yes	<i>Staph aureus</i>	Yes	6/12
6	71/M	Hypertension, carotid stenosis	—	6/9	A	SPP	s/c Gent/Bet	Maxitrol	4 Months	CF	No	No	Yes	<i>Corynebacterium diphtheroides</i>	No	6/12
7	70/M	Aplastic anaemia	—	6/18	D	SPP	s/c Gent/Bet	Maxitrol	4 Days	HM	No	No	Yes	Coag neg staph, pseudomonas	No	6/9

*Dexamethasone eye drops (Alcon). RAPD = relative afferent pupillary defect; COAD = chronic obstructive airway disease; RD = retinal detachment; PMMA = polymethylmethacrylate; SPP = silicone-polypropylene; s/c = subconjunctival; iv = intravenous; Gent = gentamicin; Bet = betnesol; Cef = Cefuroxime.

with a continuous 10/0 nylon X suture. The eye which received a rigid 5.5 mm PMMA IOL (Iolab MC550) had a superior sutureless 3.5 mm scleral tunnel. The surgical technique was otherwise similar between the two groups and did not change during the study period. At the conclusion of the procedure five patients received gentamicin subconjunctivally, one received topical chloramphenicol ointment, and one patient received no antibiotic prophylaxis at this point because of a history of drug sensitivity. Postoperatively all patients were prescribed a 4 week reducing course of topical dexamethasone, neomycin, and polymixin B to the operated eye.

Six patients presented within 10 days of cataract extraction with clinical evidence of acute endophthalmitis. A vitreous biopsy was performed in five patients and anterior chamber tap in two; coagulase negative staphylococci were isolated from three (in addition to *Pseudomonas* sp in the patient with aplastic anaemia), *Staphylococcus aureus* from one patient, and samples from one patient were culture negative. One patient did not undergo intraocular fluid sampling and was treated empirically. One patient presented 4 months postoperatively with a chronic low grade anterior uveitis which became more severe following YAG laser posterior capsulotomy. Vitreous culture in this case yielded *Corynebacterium diphtheroides*.

One patient with endophthalmitis who had received a SPP IOL had a history of idiopathic aplastic anaemia. Despite transfusions this patient was significantly neutropenic in the early postoperative period and for this reason is excluded from the statistical analysis.

Of the 772 patients who underwent cataract extraction by phacoemulsification during the study period, 622 received PMMA IOLs and 150 patients received SPP IOLs. Postoperative endophthalmitis developed in one (0.16%) of the patients with PMMA IOLs and five (3.33%) of those with SPP IOLs. The relative risk of postoperative endophthalmitis associated with the use of the SPP IOL compared with the PMMA IOL was 20.73 (95% CI= 2.44 to 176.16) (p=0.0013).

If the two cases of culture negative endophthalmitis are excluded, endophthalmitis developed in one of 622 (0.16%) patients with PMMA IOLs and three of 148 (2.03%) with SPP IOLs. The relative risk of postoperative endophthalmitis associated with the use of the

Table 2 Patients with endophthalmitis according to IOL type

IOL type	Number of patients			
	Including culture negative cases		Excluding culture negative cases	
Total patients	622	150	622	148
Patients with endophthalmitis	1	5	1	3
Percentage	(0.16%)	(3.33%)	(0.16%)	(2.03%)
Relative risk		20.73		12.61
p Value*		0.0013		0.024

*Fisher's exact test, SPP = silicone polypropylene; PMMA = polymethylmethacrylate.

SPP IOL compared with the PMMA IOL was 12.61 (95% CI 1.32 to 120.35) ($p=0.024$).

All patients with endophthalmitis were treated with topical and systemic antibiotics and six received intravitreal antibiotics. In two patients the IOL was explanted. The final visual acuities were 6/9 or better in four patients, 6/12 in two patients, and 6/18 in one patient.

Discussion

This study suggests an association between the use of three piece silicone polypropylene intraocular lenses and an increased risk of postoperative endophthalmitis following uncomplicated phacoemulsification.

The authors acknowledge the limitations of this retrospective study. There was no significant difference in mean age or sex distribution between the patients in the two IOL groups but other possible confounding elements cannot be completely excluded. We were not able to investigate the influence of possible confounding variables using multivariate analysis because the number of cases with endophthalmitis was small. Patient allocation to IOL type was unrandomised and consequent selection bias may have contributed to the observed association. Although the procedures were performed by different surgeons with unstandardised operative technique and differing prophylactic antimicrobial regimens, the surgical protocol did not change otherwise during the study period and we could identify no consistent differences in technique between the two groups. Despite the limitations in methodology, in the absence of a randomised controlled study we feel that the findings of this series add weight to existing evidence supporting an association between the use of SPP IOLs and an increased risk of postoperative endophthalmitis.

There are a number of possible explanations for the association. The use of folding silicone lenses may entail considerable manipulation after removal from the sterile packaging and before insertion into the eye. Although we know of no evidence to confirm this possibility, such manipulation may increase the risk of bacterial contamination of the IOL.

The lens materials or design may predispose to bacterial contamination of the implant before insertion or may confer greater resistance of intraocular organisms to physiological and pharmacological antibacterial defence mechanisms. Bacteria adhere to surfaces by reversible adsorption due to physical forces such as electrostatic charge and hydrophobicity, and by irreversible adherence involving bacterial production of a polysaccharide biofilm.¹⁰ Coagulase negative staphylococci are the organisms most commonly implicated in postoperative endophthalmitis,^{1 6 11} as was the case in this series, and are also associated with infections complicating the implantation of other surgical prosthetic devices. Griffiths *et al* demonstrated the adherence of *Staphylococcus epidermidis* to intraocular lenses by microscopy and viable bacterial counting.¹⁰ Raskin *et al* have demonstrated a twofold greater adher-

ence of *Staph epidermidis* to lenses with polypropylene haptics compared with all PMMA lenses using a quantitative culture method, a radioisotope technique, and scanning electron microscopy.¹² In a qualitative study using scanning electron microscopy Dilly and Holmes Sellors showed that bacteria adhere to polypropylene haptics in preference to the PMMA optic of a three piece intraocular lens, both in vitro and in vivo.¹³ They also noted that the surface of the polypropylene haptic appeared relatively irregular.

A biofilm is a functional consortium of micro-organisms organised within an extensive exopolymer matrix¹⁴ which confers relative protection from humoral and cellular immunity and from antibiotics. Bacteria introduced at the time of surgery may become sequestered within a biofilm on the IOL or on the capsule.¹⁵ Griffiths *et al* showed that adherence of *Staph epidermidis* to IOLS in vitro appears to confer greater resistance to antibiotics¹⁰ and Cusumano *et al* demonstrated that bacterial growth in vitro is significantly enhanced on silicone IOLs.¹⁶ This resistance to antibiotics and enhancement of bacterial growth may be due to differences in the surface properties of the different IOL types with differing propensities to form biofilms.

Adherence of bacteria to IOLs is likely to occur during the period immediately before implantation. The presence of therapeutic levels of antibiotics at the time of IOL implantation may be effective in limiting further bacterial proliferation. This can be achieved by systemic or local administration. Topical and subconjunctival antibiotics are in common use and the potential of intracameral antibiotics has more recently been a subject of intense interest.¹⁷

The cases of endophthalmitis reported in this small series are notable for their relatively good outcomes with six out of seven (86%) patients achieving final visual acuities of 6/12 or better. Although the difference is not statistically significant these figures compare favourably with those of a larger series where 60% achieved final visual acuities of 6/12 or better.¹⁸ Explantation of IOLs in postoperative endophthalmitis has been associated with an improved visual outcome.¹⁹ The fact that IOL explantation was performed in two cases in our series may explain the relatively good outcomes observed in this series.

The association of postoperative endophthalmitis with SPP IOLs was first suggested in a previous retrospective case-control study but the need for further evidence was expressed before firm conclusions could be drawn.⁹ On the basis of the findings of this study the authors believe that where SPP IOLs are used, IOL manipulation should be minimised and particular attention given to early antibiotic prophylaxis. A randomised controlled trial of SPP IOLs is required to further investigate their possible association with postoperative endophthalmitis.

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