

# A survey of measures used for the prevention of postoperative endophthalmitis after cataract surgery in the United Kingdom

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## Abstract

**Purpose** This study investigates the current practice of United Kingdom (UK) ophthalmologists in perioperative antibiotic and antiseptic use in cataract surgery.

**Materials and methods** A telephone interview survey was conducted with ophthalmic staff at all ophthalmic training units in the UK in October and November 2005.

**Results** The practices of a total of 800 consultants were ascertained. Preoperatively, 795 (99.4%) surgeons used povidone-iodine to prepare the skin. In all, 558 (69.8%) instilled 5 or 10% povidone-iodine in the conjunctival sac; 47 (5.9%) gave preoperative antibiotic eyedrops. Intraoperatively, intracameral antibiotics were given either as a bolus [80 (10.0%) intracameral cefuroxime, 29 (3.6%) intracameral vancomycin] or in the irrigating fluid [33 (4.1%) vancomycin]. 48 (6.0%) gave subconjunctival gentamycin only routinely, 531 (66.4%) gave subconjunctival cefuroxime, and 39 (4.9%) gave other subconjunctival antibiotics. A single dose of topical antibiotics was given by 134 (16.8%) surgeons.

Postoperatively, 515 (64.4%) used a combination steroid and neomycin eyedrop, and 213 (26.6%) gave a separate steroid and chloramphenicol eyedrop.

**Conclusions** This study reveals wide variations in the choice and duration of antibiotics used by UK ophthalmologists. The predominant methods of intraoperative prophylaxis are subconjunctival cefuroxime and intracameral cefuroxime. Most surgeons

used a neomycin eyedrop for postoperative prophylaxis.

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**Keywords:** antibiotic; cataract surgery; postoperative endophthalmitis; prevention; prophylaxis

## Introduction

There is widespread variation in the prophylactic measures used to prevent endophthalmitis following cataract surgery<sup>1</sup> but in the light of rising endophthalmitis incidence rates<sup>2,3</sup> and new scientific evidence, a reassessment of methods is required. Although rare, endophthalmitis carries a devastating prognosis, with only 33% of patients achieving visual acuity better than 6/12.<sup>4</sup> Establishing sound practice patterns to prevent postoperative endophthalmitis (POE) is therefore essential.

The rarity of POE has resulted in a paucity of high-quality studies on the effect of prophylactic measures on incidence rates. Most endophthalmitis prophylaxis guidelines, such as those from the Royal College of Ophthalmologists (RCO)<sup>5</sup> and the American Academy of Ophthalmology (AAO),<sup>6</sup> leave the details of antibiotic use to the individual surgeon's discretion, although all state the use of povidone-iodine 5–10% solution into the conjunctival sac prior to surgery is mandatory. The European Society of Cataract and Refractive Surgeons (ESCRS) guidelines on prevention of

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POE recommends intracameral cefuroxime and does not encourage subconjunctival or infusion antibiotics.<sup>7</sup>

The aim of this study was to ascertain the antibiotic and antiseptic prophylaxis practice of UK ophthalmologists for POE in cataract surgery, identify variations in practice and to compare practice with current guidelines and best available evidence.

## Materials and methods

An up to date list of all ophthalmic hospitals in the National Health Service (NHS) or Health and Social Services (HSS), and the numbers of consultant ophthalmologists in each eye unit, were obtained from the RCO Directory of Training Posts 2005–6<sup>8</sup> and the Directory of Ophthalmology Care.<sup>9</sup> Telephone interviews were conducted with the on-call ophthalmic medical staff in all 159 UK ophthalmic units in October and November 2005. Telephone calls were made by the same individual (PGB). A response was recorded as not available if three separate calls on different dates to the same department elicited no response. No attempt was made to contact private hospitals or Independent Sector Treatment Centres.

The units were classified as teaching/university hospitals or district general hospitals and the status of the responding member of staff recorded. Questions were asked to ascertain the number of consultant cataract surgeons in the unit, and the antibiotic and antiseptic prophylaxis used preoperatively, intraoperatively and postoperatively by each consultant; consultants were not named. Preoperative measures were defined as those used before the cataract operation commenced and included preoperative antibiotics (single dose or short course), skin disinfection, and povidone-iodine in the conjunctival sac either as formal instillation or during skin antisepsis allowing overspill into the conjunctival sac. Intraoperative measures referred to antibiotics given in the infusion or irrigating fluid, as an intracameral injection, subconjunctival injection or as topical antibiotic/antiseptic at the end of the operation. Postoperative measures were those used after the patient departed from the operating table. Questions were asked in an open-ended manner initially and clarified by providing options from which to choose. Validation was performed by telephoning 40% of hospitals on more than one occasion and interviewing a different staff member.

## Results

### Response rate and validation

Responses were obtained from 126 units (24 university hospitals (UH) and 102 district general hospitals (DGH)),

about the practices of each consultant cataract surgeon. The status of responding staff was senior house officer (97%), registrar (1%), or consultant (1%). In the 126 eye units, there were 800 consultant cataract surgeons. The total number of consultant ophthalmologists in the NHS/HSS was 1030. It was not possible to obtain the total number of consultant cataract surgeons in the NHS/HSS but we estimate this total to be 900. The response rate is therefore 800 out of 900 (88.9%). Validation revealed a 100% correlation of results obtained at different times for the same department.

### Preoperative prophylaxis

The vast majority of surgeons (99.4%) used povidone-iodine (or chlorhexidine if iodine-allergic) to prepare the skin. Just over two-thirds used 5 or 10% povidone-iodine in the conjunctival sac, either as formal instillation of 5% povidone-iodine or instillation on the ocular surface during skin preparation with 10% povidone-iodine (Table 1).

Preoperative topical antibiotic use is shown in Table 1. Most surgeons did not use preoperative antibiotic eyedrops and, of those that did, the most common method was a single dose of chloramphenicol. One quarter used neither topical antibiotic nor povidone-iodine.

### Intraoperative prophylaxis

Only four (0.5%) consultants used no form of intraoperative antibiotic. The predominant form of intraoperative prophylaxis was subconjunctival antibiotic (79.3%) followed by intracameral injection of antibiotic (13.6%) and antibiotic in the infusion (4.1%).

#### Subconjunctival antibiotics

The majority of consultants used subconjunctival cefuroxime (Table 1). Other subconjunctival antibiotics used were gentamycin (48), vancomycin (12), ceftazidime (11), cefotaxime (6), cefradine (5), and amikacin (5).

#### Intracameral antibiotics

In all, 142 (17.7%) consultants gave antibiotics directly into the anterior chamber, as a bolus at the end or as an infusion (Table 1). Only vancomycin was used for infusion.

#### Topical antibiotics/antiseptic

Antibiotic eyedrops were predominantly used in combination with either subconjunctival or intracameral antibiotic. Very few consultants used antibiotic eyedrops as the only means of intraoperative prophylaxis and these were chloramphenicol combined with gentamycin

**Table 1** Perioperative prophylaxis methods: the numbers and percentages of consultants using each method

Method	Consultant cataract surgeons	
	Total (N = 800)	Percentage (95% CI)
<b>Preoperative eyedrops</b>		
<i>Antibiotic</i>		
Chloramphenicol stat	31	3.9 (2.7–5.5)
Chloramphenicol qds × 3 days	9	1.1 (0.6–2.1)
Ofloxacin stat	7	0.9 (0.4–1.8)
Total antibiotics	47	5.9 (4.4–7.7)
Nil	753	94.1 (92.3–95.5)
<i>Antiseptic</i>		
Povidone-iodine/chlorhexidine	558	69.8 (66.5–72.8)
Nil	242	30.2 (27.2–33.5)
Total antibiotic or antiseptic	598	74.8 (71.6–77.6)
No antibiotic or antiseptic	202	25.2 (22.4–28.4)
<b>Intraoperative</b>		
<i>SC antibiotic</i>		
Gentamycin	48	6.0 (4.6–7.9)
Cefuroxime	531	66.4 (63.0–69.6)
Cefuroxime + gentamycin	16	2.0 (1.2–3.2)
Other	39	4.9 (3.6–6.6)
Total antibiotics	634	79.3 (76.3–81.9)
Nil	166	20.7 (18.1–23.7)
<i>IC antibiotic</i>		
Cefuroxime bolus	80	10.0 (8.1–12.3)
Vancomycin bolus	29	3.6 (2.5–5.2)
Vancomycin infusion	33	4.1 (2.9–5.7)
Nil	658	82.2 (79.4–84.7)
<i>Antibiotic/antiseptic eyedrops</i>		
Eyedrops with SC/IC antibiotic	114	14.2 (12–16.8)
Eyedrops alone	20	2.5 (1.6–3.8)
Total eyedrops	134	16.8 (14.3–19.5)
Nil	666	83.2 (80.5–85.7)
Gentamycin	39	4.9 (3.6–6.6)
Chloramphenicol	100	12.5 (10.4–15.0)
Povidone-iodine	20	2.5 (1.6–3.8)
Fusidic acid	6	0.8 (0.3–1.6)
<b>Postoperative antibiotic drops</b>		
Polymyxin B and neomycin (maxitrol)	315	39.4 (36.0–42.8)
Neomycin (betnesol-N)	200	25.0 (22.1–28.1)
Neomycin all	515	64.4 (61–67.6)
Chloramphenicol	213	26.6 (23.7–29.8)
Tobramycin (tobradex)	29	3.6 (2.5–5.2)
Flouroquinolone	16	2.0 (1.2–3.2)
Nil (steroid only)	25	3.1 (2.1–4.6)
Other	2	0.2 (0.07–0.9)

or 1% povidone-iodine, or a neomycin-steroid eyedrop. 6 (0.7%) consultants used povidone-iodine drops as the only intraoperative prophylactic measure.

### Postoperative prophylaxis

The majority of consultants used an eyedrop containing neomycin and steroid, and most of the remainder used chloramphenicol (Table 1). In all, 560 (70%) of surgeons used the antibiotic eyedrop for duration greater than 1 week (2–4 weeks).

### Type of hospital and size of department

Significantly more UH consultants than DGH consultants used conjunctival povidone-iodine (Table 2). Preoperative and intraoperative antibiotic eyedrops were used more in the DGHs. DGH surgeons were significantly in favour of combined steroid-neomycin drops postoperatively whereas only half of UH consultants used these, the rest using predominantly chloramphenicol eyedrops.

There were fewer differences related to the size of the department, but preoperative chloramphenicol was used more, and conjunctival povidone-iodine less, by smaller departments (Table 3). Intracameral vancomycin use was confined to intermediate-sized departments.

### Discussion

We present up-to-date information on prophylactic antibiotic and antiseptic use in cataract surgery in the UK. The survey achieved a high response rate of 88.9%, exceeding the response rates from previous studies.<sup>10,11</sup> It provides the first data on the use of intracameral antibiotics. This is also the first survey on the subject to employ telephone interviews for data collection and the method offers advantages over postal surveys, as direct dialogue between the person conducting the survey and the person being questioned allows immediate clarification of answers and possible uncertainties. The method also achieves a high response rate. Validation by repeated telephone interviews on different occasions with new individuals from the same ophthalmic unit, ensured that the data obtained for each institution was accurate. This survey collected data on the methods used for prophylaxis of endophthalmitis by consultant ophthalmologists working in 126 out of the 159 NHS Ophthalmic units offering training. A sample of this size is likely to be an accurate reflection of current cataract surgical practice in the UK.

### Preoperative prophylaxis

#### *Povidone-iodine antiseptics*

Povidone-iodine 10% solution (or chlorhexidine if allergy) is recommended for preparation of the skin as a

**Table 2** Perioperative prophylaxis method and the number and percentage of consultant cataract surgeons by hospital type

Method	Consultant cataract surgeons and hospital type			
	Number of UH surgeons	% of UH surgeons (of n = 257)	Number of DGH surgeons	% of DGH surgeons (of n = 543)
<b>Preoperative eyedrops</b>				
<i>Antibiotic</i>				
Chloramphenicol stat	1	0.4	30	5.5
Chloramphenicol course	0	0	9	1.6
Ofloxacin	0	0	7	1.3
Total antibiotics	1	0.4	46	8.5
Nil	256	99.6	497	91.5 $P < 0.001$ , 1df
<i>Antiseptic</i>				
Povidone-iodine/chlorhexidine	213	82.9	345	63.5
Nil	44	17.1	198	36.5 $P < 0.001$ , 1df
Total antibiotic or antiseptic	214	83.3	384	70.7
No antibiotic or antiseptic	43	16.7	159	29.3 $P < 0.001$ , 1df
<b>Intraoperative</b>				
<i>SC antibiotic</i>				
Gentamycin	10	3.9	38	7
Cefuroxime	175	68.1	356	65.5
Cefuroxime + gentamycin	0	0	16	2.9
Other	18	7	21	3.9
Total antibiotics	203	79	431	79.4
Nil	54	21	112	20.6
<i>IC antibiotic</i>				
Cefuroxime bolus	31	12.1	49	9
Vancomycin bolus	7	2.7	22	4
Vancomycin infusion	8	3.1	25	4.6
Nil	211	82.1	447	82.3
<i>Antibiotic/antiseptic eyedrops</i>				
Eyedrops with SC/IC antibiotic	13	5	101	18.6
Eyedrops alone	0	0	20	3.7
Total eyedrops	13	5	121	22.3
Nil	244	95	422	77.7 $P < 0.001$ , 1df
Gentamycin	12	4.7	27	5
Chloramphenicol	13	5	87	16
Povidone-iodine	0	0	20	3.7
Fusidic acid	0	0	6	1.1
<i>Postoperative antibiotic drops</i>				
Polymyxin B and neomycin (maxitrol)	65	25.3	250	46
Neomycin (betnesol-N)	61	23.7	139	25.6
Neomycin total	126	49	389	71.6
Chloramphenicol	105	40.8	108	19.9 $P < 0.001$ , 3df
Tobramycin, fluoroquinolone, other	13	5	34	6.3
Nil (steroid only)	13	5	12	2.2

10% solution<sup>12</sup> and almost all surgeons surveyed complied.

A single topical application of 5% povidone-iodine in the conjunctival sac was the first convincingly proven prophylactic measure in reducing the rate of POE.<sup>13,14</sup> Povidone-iodine achieves 96.7% bacterial kill within one minute of irrigation.<sup>15</sup> However, in our survey nearly one

third of consultants were reported as not employing this essential prophylactic measure.

#### *Antibiotic eyedrops*

The ESCRS study has concluded that although the use of perioperative levofloxacin eyedrops as prophylaxis was also associated with a reduction in the observed

**Table 3** Perioperative prophylaxis method and the number and percentage of cataract surgeons by the size of the eye department

Perioperative prophylactic method	Size of department (number of consultant cataract surgeons)					
	4 or less N = 126		5–9 N = 410		10 or more N = 264	
	Number	%	Number	%	Number	%
<b>Preoperative eyedrops</b>						
<i>Antibiotic</i>						
Chloramphenicol stat	16	12.7	1	0.2	14	5.3
Chloramphenicol course	3	2.4	6	1.5	0	0
Ofloxacin	0	0	7	1.7	0	0
Total antibiotic	19	15.1	14	3.4	14	5.3
Nil	107	84.9	396	96.6	250	94.7 $P < 0.001$ , 2df
<i>Antiseptic</i>						
Povidone-iodine/chlorhexidine	75	59.5	293	71.5	190	72
Nil	51	40.5	117	28.5	74	28 $P = 0.02$ , 2df
Total antibiotic/antiseptic	89	70.6	302	73.7	204	77.3
No antibiotic or antiseptic	37	29.4	108	26.3	60	22.7
<b>Intraoperative</b>						
<i>SC antibiotic</i>						
Gentamycin	18	14.3	25	6.1	5	1.9
Cefuroxime	78	61.9	255	62.1	198	75
Cefuroxime + gentamycin	5	4	11	2.7	0	0
Other	0	0	20	4.9	19	7.2
Total antibiotics	101	80.1	311	75.8	222	84.1
Nil	25	19.8	99	24.2	42	15.9
<i>IC antibiotic</i>						
Cefuroxime bolus	19	15.1	39	9.5	22	8.3
Vancomycin bolus	0	0	29	7.1	0	0
Vancomycin infusion	0	0	33	8	0	0
Nil	107	84.9	309	75.4	242	91.7
<i>Antibiotic/antiseptic eyedrops</i>						
Eyedrops + SC/IC antibiotic	6	4.8	66	16.1	42	15.9
Eyedrops alone	4	3.2	16	3.9	0	0
Total eyedrops	10	7.9	82	20	42	15.9
Nil	116	92.1	328	80	222	84.1
Gentamycin	4	3.2	10	2.4	25	9.5
Chloramphenicol	12	9.5	33	8	55	20.8
Povidone-iodine	7	5.5	13	3.2	0	0
Fusidic acid	0	0	6	1.5	0	0
<i>Postoperative antibiotic drops</i>						
Polymyxin B and neomycin (maxitrol)	61	48.4	175	42.7	79	29.9
Neomycin (betnesol-N)	15	11.9	113	27.6	72	27.3
Total neomycin	76	60.3	288	70.2	151	57.2
Chloramphenicol	39	30.9	80	19.5	94	35.6
Tobramycin, flouroquinolone, other	9	7.1	28	6.8	10	3.8
Nil (steroid only)	2	1.6	14	3.4	9	3.4

incidence rate of postoperative endophthalmitis, this effect was small and was not statistically significant.<sup>16</sup>

The predominant UK practice of not using a preoperative antibiotic is supported by the fact that one drop of 5% povidone-iodine preoperatively is equivalent to topical antibiotic used three times a day for 3 days in reducing ocular surface flora.<sup>17</sup>

### ***Intraoperative prophylaxis***

#### *Subconjunctival antibiotics*

This was the most commonly used means of intraoperative prophylaxis in this survey, but still has no well-designed prospective trials in its favour, and large literature reviews have not recommended it as effective

prophylaxis.<sup>18</sup> Two retrospective studies in the UK have shown an association between non-administration of subconjunctival cefuroxime and POE<sup>19,20</sup> and a German survey<sup>14</sup> suggested that subconjunctival antibiotics decrease the incidence of endophthalmitis. The absence of any cases of POE in a series of 8856 consecutive cataract extractions has been used to support the administration of subconjunctival antibiotics.<sup>21</sup> Although the toxicity of subconjunctival gentamycin to the conjunctiva has been demonstrated,<sup>22</sup> 6% of consultants in this study still use it as their primary means of intraoperative prophylaxis; most consultants used this only if there was allergy to cephalosporins.

#### *Intracameral antibiotics*

The best and most recent evidence for intracameral antibiotics is the ESCRS multicentre, prospective, randomised partially-blind study which showed a fivefold reduction in endophthalmitis rates with intracameral cefuroxime use.<sup>16</sup> In a national 3-year prospective uncontrolled survey conducted in Sweden, a statistically significant reduction in POE was found in patients who had received intracameral cefuroxime in comparison to those treated with topical or subconjunctival antibiotics.<sup>23</sup> The most recent UK survey on prophylactic measures did not report on intracameral bolus antibiotic use.<sup>10</sup> The North of England survey in 2003 reported its use in 10% of those surveyed<sup>11</sup> and it is apparent that the intracameral antibiotic use in the UK has increased (13.6% in our survey). The safety and kinetics of intracameral cefuroxime have been well evaluated.<sup>24,25</sup> There has been only one report of an anaphylactic reaction to intracameral cefuroxime in a penicillin-allergic patient.<sup>26</sup>

The rationale for intracameral administration of antibiotic is to achieve a guaranteed bactericidal concentration in the anterior chamber. Intracameral cefuroxime achieves higher aqueous concentration (756 mg/l)<sup>24</sup> 1 h after surgery than subconjunctival cefuroxime (20 mg/l).<sup>27</sup> Endocapsular antibiotic may even be more effective. Gimbel *et al*<sup>28</sup> used irrigating gentamycin and vancomycin in the capsular bag at the end of surgery and reported no endophthalmitis in 11,748 procedures.

#### *Infusion antibiotics*

The predominant intraocular use of antibiotics in the US<sup>29</sup> and Germany<sup>14</sup> is as an infusate in the irrigating fluid, most commonly vancomycin alone or in combination with gentamycin. It is uncommon elsewhere<sup>10,30</sup> as found in our study. Although safe, routine prophylactic vancomycin use is discouraged because of a lack of scientific evidence for an effect on POE rates and fear of developing resistance.<sup>7,31</sup>

#### *Postoperative antibiotics*

Few consultants in our survey used no antibiotic at all postoperatively. The rationale for their use is to reduce ocular surface bacterial contamination and achieve bacteriostatic and bactericidal anterior chamber levels, potentially eliminating postoperative microcontamination and preventing POE. Studies on postoperative antibiotic use are sparse, despite common use. One retrospective study showed that commencing topical antibiotics on the day of surgery, rather than the following day, significantly reduced POE rates.<sup>32</sup> The duration of antibiotic use was >2 weeks for 70% of the surgeons we surveyed. It has been suggested that postoperative antibiotic drops be limited to one week to prevent the emergence of antibiotic resistance,<sup>32</sup> and the ESCRS guidelines recommend no more than 2 weeks unless medically indicated.

#### *Neomycin vs chloramphenicol*

Nearly 2/3 of the surgeons surveyed employed the use of a neomycin-containing eyedrop (betnesol-N or maxitrol). Maxitrol contains polymyxin B as well, which provides some Gram-negative cover. The remaining 1/3 used an antibiotic eyedrop (usually chloramphenicol) and a separate steroid eyedrop. Neomycin is well known for its allergic response in 4% of patients and more importantly its lack of activity against the Gram-positive bacteria, mainly coagulase-negative staphylococcus (CNS),<sup>33</sup> which are the most common ocular surface organisms and the major cause of POE. Chloramphenicol provides better activity against CNS than neomycin and chloramphenicol is comparable to fourth generation fluoroquinolones against CNS.<sup>33</sup>

#### *Chloramphenicol vs fluoroquinolones*

Aminoglycosides (except neomycin) and the fluoroquinolones, particularly levofloxacin provide better coverage against Gram-positive and Gram-negative bacteria than chloramphenicol.<sup>34</sup> In our study, very few consultants used fluoroquinolones postoperatively. This is markedly different from the USA where fluoroquinolones are used routinely postoperatively.<sup>3</sup> One study correlated reduction of endophthalmitis rates with ofloxacin *vs* ciprofloxacin use and recommended the newer fluoroquinolones, gatifloxacin or moxifloxacin, in light of resistance to second generation fluoroquinolones.<sup>32</sup> There is, however, a large rate of cross resistance for *Staphylococci* between all the fluoroquinolone generations.<sup>35</sup> Compared to the first and second generation fluoroquinolones, chloramphenicol is less expensive and exhibits similar resistance among CNS, less resistance in *Streptococcus* species but more frequent resistance by Gram-negative bacteria.<sup>34</sup>

## Conclusions

We present an up-to-date, high response rate survey of antibiotic and antiseptic POE prophylaxis use by UK cataract surgeons. We have analysed the findings in the context of current knowledge on the efficacy of various forms of POE prophylaxis. A significant minority (1/3rd) are failing to use preoperative conjunctival povidone iodine, despite its widespread acceptance as the only convincingly proven prophylactic method.

Subconjunctival cefuroxime is still the predominant antibiotic prophylaxis although intracameral bolus antibiotics are starting to gain acceptance and their use is strongly supported by the recent ESCRS multicentre prospective study. The widespread use of postoperative neomycin is illogical given its inadequate spectrum of activity against the likely causative agents of POE and a high rate of allergy.

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