

# Acute endophthalmitis after cataract surgery: a 10-year review (2003 – 2013)

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## Abstract

**Aims:** Acute endophthalmitis is a potentially sight-threatening complication of cataract surgery. The aim of this study was to evaluate the incidence, microbiology and clinical outcomes of patients with post-cataract surgery endophthalmitis in a public hospital in Hong Kong.

**Methods:** This was a retrospective case series that reviewed patients who underwent cataract surgery and were diagnosed to have acute postoperative endophthalmitis between 1 April 2003 and 31 March 2013 at the Hong Kong Eye Hospital. Main outcome measures were incidence, culture results and visual acuity at the final visit.

**Results:** A total of 31 patients were diagnosed with acute postoperative endophthalmitis out of 46,564 cataract surgeries performed over 10 years. The mean annual incidence rate was 0.067%. A positive culture was found in 72.4% of the intraocular samples. The yield of anterior chamber and vitreous tapping was 39.3% and 57.1%, respectively. Over 95% of isolates were Gram-positive organisms and the most common pathogen was coagulase-negative staphylococcus. At the last follow-up (mean, 28.4 months; range, 2.1-86.3 months), over two-

thirds of the patients achieved a visual acuity of 0.3 or more. Presenting visual acuity was positively associated with final visual outcome ( $p < 0.05$ ).

**Conclusions:** The results of this 10-year review may serve as a reference for local data on acute endophthalmitis after cataract surgery for other centres and future studies.

*Key words:* Cataract extraction; Endophthalmitis; Microbiology

## Introduction

Cataract extraction is one of the most commonly performed ophthalmic procedures globally. In Hong Kong, 27,345 cataract surgeries were performed in all seven clusters of the Hospital Authority from 2012 to 2013.<sup>1</sup> Acute endophthalmitis is a rare but potentially sight-threatening complication of cataract surgery. Studies in the recent decades have reported the incidence of acute endophthalmitis after cataract surgery to range from 0.025% to 0.33% worldwide.<sup>2-11</sup> However, there is a lack of such published data locally.

The purpose of the current study was to investigate the incidence and microbiology of acute endophthalmitis after cataract surgery at the Hong Kong Eye Hospital (HKEH) over the most recent 10 years, namely, from 2003 through

2013, and assess the clinical outcomes after treatment.

## Methods

The study design was a retrospective consecutive case series. The clinical and microbiological records of patients who underwent cataract surgery at HKEH and were subsequently diagnosed with acute postoperative endophthalmitis from 1 April 2003 to 31 March 2013 were reviewed. The study protocol was approved by the Research Ethics Committee of Kowloon Central and Kowloon East Clusters of the Hospital Authority.

Cataract extractions, either standard extracapsular cataract extraction (ECCE) or phacoemulsification, with or without an intraocular lens insertion, performed during the study period were included. Since 2002, the Infection Control Team of HKEH has established a mandatory reporting system of acute postoperative endophthalmitis following intraocular surgeries and prospectively recorded these cases on standardized notification forms. Acute postoperative endophthalmitis was defined as a clinical diagnosis in patients with ophthalmic features of endophthalmitis, with or without microbiological evidence, within 6 weeks of intraocular surgery. Known cases of infection or penetrating ocular injuries were excluded. Ophthalmic features of endophthalmitis included pain or decreased visual acuity, and marked intraocular inflammation.

As standard measures for preoperative antisepsis in all patients, tobramycin eyedrops were applied every 15 minutes for 4 times 1 hour before surgery. Further, 10% povidone iodine was applied to periocular skin and 5% was instilled into the conjunctival sac and left for at least 5 minutes in the operating theatre. No antibiotic was used in the irrigating solution or as intracameral injection during surgery. Postoperatively, topical antibiotics, most commonly chloramphenicol followed by levofloxacin, and steroid were prescribed routinely for 4 to 8 weeks. In cases of acute, clinical postoperative endophthalmitis, the choice of treatment was left at the discretion of the treating physician.

Data collected included patients' age, sex, medical conditions, date and type of initial cataract surgery, date of diagnosis of endophthalmitis, onset and presenting features, date and type of treatment, microbiological profile, follow-up dates and visual acuity.

The data acquired were summarized with descriptive statistics. Incidence rates in patients receiving phacoemulsification and ECCE were compared using Fisher's exact test. For subgroup analyses, Snellen best-corrected visual acuity (BCVA) was converted to logarithm of minimal angle of resolution (logMAR) equivalents and BCVA of counting fingers, hand movements, light perception and no light perception were assigned logMAR values of 1.85, 2.3, 2.7, 3.0, respectively, as proposed in previous studies.<sup>12,13</sup> Multivariable linear regression models were used to individually assess the association of presenting visual acuity, days to onset of symptoms, culture results and type of initial treatment with final visual acuity outcome, adjusting for age, sex and systemic diseases. In the regression model for type of initial treatment and final visual acuity outcome, we additionally adjusted for presenting visual acuity. All analyses were performed in Stata release 12.1 (StataCorp, College Station [TX], USA). A p value of less than 0.05 (2-sided test) was considered statistically significant.

## Results

From 1 April 2003 to 31 March 2013, 31 patients were identified as having acute postoperative endophthalmitis. During these 10 years, a total of 46,564 cataract surgeries were performed, including 37,030 (79.5%) phacoemulsifications and 9534 (20.5%) ECCEs. The overall mean annual incidence rate of acute endophthalmitis after cataract surgery was 0.067% (31/46,564), 0.075% for phacoemulsification and 0.031% for ECCE ( $p = 0.064$ ). The annual incidences are summarized in **Table 1**. The annual incidence varied but no clustering or outbreak was ever identified.

Of the 31 patients, two were excluded from further analyses

**Table 1. Incidence of acute endophthalmitis after cataract extraction, 2003 – 2013**

Year	No. of cataract surgeries	No. of endophthalmitis cases	Incidence (%)
2012-13	6317	8	0.13
2011-12	6267	0	0.00
2010-11	5696	5	0.09
2009-10	4699	3	0.06
2008-09	3893	1	0.03
2007-08	4023	5	0.12
2006-07	3940	4	0.10
2005-06	4031	2	0.05
2004-05	4000	2	0.05
2003-04	3698	1	0.03

Table 2. Demographics and perioperative factors							
Patient No.	Age (years)	Sex	Major medical illnesses	Eye	Surgery	Duration of surgery (mins)	Intraoperative complications
1	57	M	-	OS	Phaco	21	-
2	81	M	DM	OD	Phaco	24	-
3	67	M	-	OS	Phaco	18	-
4	74	F	DM, RF	OD	Phaco	25	PCR + AV
5	90	M	-	OS	Phaco	25	-
6	60	F	-	OS	ECCE	75	PCR + AV
7	85	M	DM, HF	OD	Phaco	35	-
8	82	M	COAD	OS	Phaco	17	-
9	76	M	-	OD	Phaco	23	-
10	87	M	-	OD	Phaco	30	-
11	55	M	-	OD	Phaco	20	-
12	57	M	-	OD	Phaco	16	-
13	76	F	DM	OD	Phaco	35	-
14	79	M	DM, HF, RF	OS	Phaco	25	-
15	76	F	DM	OD	Phaco	15	-
16	82	F	RF	OD	Phaco	45	-
17	67	F	DM	OS	Phaco	20	-
18	71	M	-	OD	Phaco	30	-
19	68	M	-	OD	Phaco	30	-
20	75	F	-	OD	Phaco	20	-
21	81	M	-	OD	Phaco	35	-
22	85	F	-	OD	Phaco	15	-
23	72	F	-	OD	ECCE	30	-
24	49	M	-	OD	Phaco	20	IP
25	64	M	-	OD	Phaco	11	-
26	74	M	-	OD	Phaco	30	-
27	39	M	-	OS	Phaco	18	-
28	80	M	-	OD	Phaco	17	-
29	82	F	DM	OD	Phaco	30	-

Abbreviations: AV = anterior vitrectomy; COAD = chronic obstructive airway disease; DM = diabetes mellitus; ECCE = extracapsular cataract extraction; HF = heart failure; IP = iris prolapse; OD = right eye; OS = left eye; PCR = posterior capsular rupture; Phaco = phacoemulsification; RF = renal failure.

due to unavailable medical records. Patient demographics and perioperative factors of the 29 patients are summarized in **Table 2**. The mean age of the patients was 72 years (range, 39-90 years). There were 19 (65.5%) males and 21 right eyes (72.4%); eight patients (27.6%) had a history of diabetes mellitus and five (17.2%) had a major medical illness including renal failure, heart failure and chronic obstructive airway disease.

The clinical course, initial treatment and culture data are presented in **Table 3**. At initial presentation, presenting visual acuity was 20/200 or better in 3 (10.3%), counting fingers to hand movements in 15 (51.7%), and light perception in 6 (20.7%) of the 29 eyes. The mean time from initial cataract surgery to onset of endophthalmitis symptoms was 3.7 days (range, 1-9 days); 25 (86%) patients presented within the first week of surgery. All eyes in this series were

initially treated with intravitreal antibiotic injection preceded by either an anterior chamber and/or vitreous tapping, or a pars plana vitrectomy (PPV). The most frequently used antibiotic included a combination of vancomycin and amikacin (86.2%). Six patients (20.7%) had primary PPV and nine (31%) had PPV as second intervention due to clinical deterioration.

Both aqueous and vitreous taps were performed in all except one eye. Case 6 only had a vitreous tap. In addition, case 23 had both aqueous and vitreous taps but the vitreous culture result was not retrievable from the electronic record. Overall, the intraocular samples were culture-positive in 21 eyes (72.4%). The yield of anterior chamber and vitreous taps was 39.3% (11/28) and 57.1% (16/28), respectively. Of the identified isolates, 95.2% (20/21) were Gram-positive organisms. Coagulase-negative staphylococci (CNS) were

Table 3. Clinical course, initial treatment and culture data								
Patient No.	Presenting VA	Initial treatment (antibiotics)		Culture		Coagulase-negative <i>Staphylococcus</i>	VA at last follow-up (months)	
				Aq	Vit			
1	HM	T/I	(V,A)	-	-	-	HM	(12.4)
2	3/60	T/I	(V,G)	-	-	-	0.3	(28.7)
3	LP	PPV	(V,A)	+	-	-	0.7	(35.9)
4	0.2	T/I	(V,A)	+	+	+	0.1	(43.5)
5	LP	PPV	(V,A)	+	+	-	N/A	
6	HM	T/I	(V,A)	N/D	-	-	0.4	(3.5)
7	LP	PPV	(V,G)	-	+	+	0.3	(2.1)
8	0.5/60	T/I	(V,A)	-	+	+	0.7	(2.8)
9	HM	PPV	(V,A)	-	-	-	0.1	(17.6)
10	HM	T/I	(V,A)	-	+	+	0.2	(70.5)
11	HM	T/I	(V,A)	-	-	-	0.1	(50.9)
12	HM	T/I	(V,A)	-	+	-	0.7	(3.9)
13	0.5/60	T/I	(V,A)	-	+	+	0.3	(29.0)
14	LP	PPV	(V,A)	+	+	-	NLP	(14.8)
15	0.1	T/I	(V,A)	+	-	-	0.8	(71.6)
16	LP	T/I	(V,A)	+	-	-	LP	(3.0)
17	LP	T/I	(V,A)	+	+	-	HM	(33.0)
18	HM	T/I	(V,A)	+	-	-	0.3	(64.7)
19	FC	T/I	(V,A)	-	+	+	0.1	(86.3)
20	HM	T/I	(V,A)	+	+	+	0.4	(31.7)
21	HM	T/I	(V,A)	-	-	-	N/A	
22	2/60	T/I	(V,A)	-	+	+	0.7	(6.9)
23	0.2	T/I	(V,A)	-	N/D	-	0.8	(28.0)
24	HM	T/I	(V,C)	+	-	+	0.8	(3.5)
25	FC	T/I	(V,A)	-	-	-	0.5	(5.8)
26	HM	T/I	(V,A)	-	+	+	0.6	(47.0)
27	HM	T/I	(V,C)	+	+	+	0.7	(5.5)
28	2/60	T/I	(V,A)	-	+	+	0.4	(10.1)
29	HM	PPV	(V,A)	-	+	-	0.3	(25.5)

Abbreviations: A = amikacin; Aq = aqueous; C = ceftazidime; FC = finger count; G = gentamycin; HM = hand movement; LP = light perception; N/A = not available; N/D = not done; NLP = no light perception; PPV = pars plana vitrectomy; T/I = tapping and injection; V = vancomycin; VA = visual acuity; Vit = vitreous.

the most commonly identified organisms. All CNS in the current series were sensitive either to a penicillin group of antibiotics or vancomycin. Polymicrobial infection was found in five eyes. No fungus was isolated. **Table 4** summarizes the results of bacterial cultures.

Of the 29 patients, 27 were followed up for a mean of 28.4 months (range, 2.1-86.3 months). Two patients were lost to follow-up since the initial treatment and these were excluded from analyses of visual outcomes. Final visual acuity of 0.3 or better was achieved in 19 (70.4%), and of 0.5 or better in 10 (37.0%) of the 27 eyes. Two eyes had final visual acuity of hand motion, one with light perception and one with no light perception. None received evisceration or enucleation due to the endophthalmitis.

Patients with better presenting visual acuity were associated with significantly better final visual acuity ( $\beta = 0.58$ , 95%

Table 4. Results of bacterial culture	
Bacteria	No. (%) of eyes
Gram-positive	
Coagulase-negative <i>Staphylococcus</i>	13 (44.8)
<i>Bacillus</i> species	4 (13.8)
<i>Streptococcus pneumoniae</i>	2 (6.9)
Other <i>Streptococcus</i> species	2 (6.9)
<i>Enterococcus</i> species	2 (6.9)
<i>Micrococcus</i> species	1 (3.4)
Gram-negative	
<i>Chryseobacterium</i> species	1 (3.4)
<i>Flavobacterium</i> species	1 (3.4)
Polymicrobial	5 (17.2)

confidence interval, 0.01-1.15), adjusted for age, sex and systemic diseases ( $p = 0.046$ ). Days from initial cataract

surgery to onset of symptoms, culture results and primary treatment option were not significantly associated with final visual acuity ( $p > 0.05$ ).

## Discussion

The purpose of this retrospective observational series was to document the incidence, microbiology and outcomes of acute endophthalmitis after cataract surgery in a public hospital in Hong Kong. The annual incidence of acute endophthalmitis after cataract surgery was 0.067%. Over 95% of the microbiological isolates were Gram-positive bacteria and CNS were the most frequently identified organisms (44.8%). The cultured CNS showed high susceptibility to either a penicillin group of antibiotics or vancomycin. The visual outcomes remained suboptimal with about one-third of patients achieving a final visual acuity of 0.5 or better.

One of the interesting findings was the observation that phacoemulsification was associated with a 2.4-fold increased risk of endophthalmitis than ECCE, though not reaching statistical significance ( $p = 0.06$ ). One of the possible mechanisms was construction of clear corneal incisions with a sharp blade was less controlled, resulting in a wound that was less resistant to external deformities and which might not be consistently self-sealing.<sup>14</sup> This may allow influx of extraocular fluid through the sutureless incisions during the postoperative period.<sup>15</sup> However, the relationship between an unsutured, clear corneal incision and increased risk of postoperative endophthalmitis has remained uncertain.<sup>16</sup> Moreover, the use of topical anesthesia was common in sutureless, clear corneal incisions in phacoemulsification; this rendered draping of the lashes and lid margins, which were well-established sources of causative microbes of endophthalmitis,<sup>17</sup> less effective compared to block anesthesia.<sup>14</sup>

The 72.4% culture-positive rate was similar to that in other studies. For example, the Endophthalmitis Vitrectomy Study (EVS) reported a 69% culture-positive rate<sup>18</sup> and the European Society of Cataract and Refractive Surgeons Endophthalmitis Study Group reported a 48.3% culture-positive rate.<sup>19</sup> The latter employed polymerase chain reaction (PCR) testing in culture-negative cases and the yield increased by 20%.<sup>19</sup> A French study also showed that PCR was more effective in detecting bacteria in vitreous samples with previous intravitreal injection of antibiotics.<sup>20</sup> However, this technique was not available for routine use in our locality. In accord with the EVS,<sup>18</sup> culture positivity was higher in vitreous than aqueous samples in the current study. However, in 5 cases, aqueous samples were positive while vitreous samples negative. Therefore, whenever possible, both aqueous and vitreous aspirates should be obtained to maximize the microbiological yield.

Endophthalmitis isolates in the current series were predominantly Gram-positive organisms (95%) and CNS were the most common pathogens; these findings are in

agreement with those from previous studies.<sup>18,21</sup> All the CNS isolates were sensitive to either a penicillin group of antibiotics or vancomycin. The rest of the Gram-positive organisms exhibited similar antibiotic sensitivity to penicillin group of antibiotics, except one isolate showing heavy growth of *Streptococcus pneumoniae* which was sensitive to levofloxacin and cefotaxime. This patient received vitrectomy and intravitreal vancomycin and amikacin, with subsequent topical levofloxacin. The final visual acuity was light perception. Previous reports of streptococcal endophthalmitis were generally associated with poor visual outcomes.<sup>22</sup> In the current study, the occurrence of Gram-negative isolates was too rare for any meaningful comparisons.

Prompt use of effective antimicrobial regimen is of paramount importance in determining the outcomes of acute endophthalmitis after cataract surgery.<sup>23</sup> The most frequently used intravitreal antibiotics were vancomycin and amikacin in our series. Ceftazidime or gentamycin were occasionally used in place of amikacin, but in general, falling out of favor due to vitreal precipitates<sup>24</sup> and retinal toxicity,<sup>25</sup> respectively. Antibiotic susceptibility data from the current study further supported continued use of the regimen of intravitreal injection of vancomycin and amikacin as an effective empirical treatment for acute postoperative endophthalmitis in our locality.

Visual outcomes after endophthalmitis were generally poor, and 34.5% of the eyes achieved a final visual acuity of 0.5 or better. In the current study, only presenting visual acuity was found to be positively associated with final visual outcome ( $p = 0.046$ ).

The current study is limited by its retrospective nature and relatively small sample size. As the diagnosis of acute endophthalmitis is clinical, entities that can give a similar clinical picture of severe ocular inflammation such as toxic anterior segment syndrome<sup>26</sup> or other non-infectious inflammation may overestimate the incidence, especially in culture-negative cases. The incidence may also be underestimated as affected patients may have sought treatment elsewhere. One case of endophthalmitis was notified by another public hospital but the between-hospital reporting was not systematic.

## Conclusion

This study provides data on the incidence, microbiology and clinical outcomes of acute endophthalmitis after cataract surgery in a Hong Kong public hospital. Our findings are, in general, consistent with those from previous clinical studies of acute endophthalmitis. The results of this 10-year review may serve as a future reference.

## Declaration

No conflicts of interests were declared by authors.

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