Incidence and visual outcome of endophthalmitis after cataract surgery – Experience of a single eye department in Scotland

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Incidence and visual outcome of acute endophthalmitis after cataract surgery – Experience of a single eye department in Scotland

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Abstract

Aim

Endophthalmitis remains one of the most dreaded complications of modern cataract surgery. Its nationwide incidence has been estimated but published data on accurate incidence at regional level is scarce. This audit examines incidence and visual outcome of endophthalmitis from a single eye department in Scotland over a 7 year period. Findings are compared with those from other series.

Methods

A retrospective consecutive audit of all cases of acute endophthalmitis treated between 1st January 2000 and 31st December 2006 at the Southern General Hospital in Glasgow was undertaken. Details of each case in relation to presentation, treatment and outcome of endophthalmitis were recorded. Cross-tabulations were performed to identify prognostic factors of visual outcome.

Results

Twenty-five patients were treated for endophthalmitis over the audit period. The incidence of endophthalmitis was 0.20% (95% confidence interval, 0.10-0.30%). There were 12 (48%) culture positive cases with coagulase negative staphylococcus accounting for 58%. After treatment, sixteen patients (64%) achieved driving standard vision or better. Poor vision at presentation and streptococcal endophthalmitis were associated with poor visual outcome.

Conclusion

The incidence of endophthalmitis in this series is comparable to larger studies suggesting that accepted benchmarks, despite being estimates, reflect UK practice. Visual outcome, with treatment, can be favourable in a significant proportion of patients.

Introduction

Advances in cataract extraction over the last decade, driven in part by the transition from extracapsular to phacoemulsification surgery, have made this intervention one of the most frequently performed in the United Kingdom (UK) [1]. Approximately 300 000 operations are carried out annually amidst high public expectations of good visual outcome and speedy recovery [1]. Post-operative endophthalmitis remains one of the most visually devastating complications of cataract surgery. In the UK, national standards have been established via the Department of Health funded National Cataract Surgery Surveys (NCSS) in 1990 and 1998 [2, 3]. The British Ophthalmological Surveillance Unit (BOSU) also runs a prospective surveillance programme for all cases of post-operative endophthalmitis via its monthly reporting card system. An incidence rate of 0.14%, with accompanying epidemiological data, was reported in 2004 based on a surveillance period from October 1999 to September 2000 [4]. One of the observations of the BOSU survey was that few centres in the UK kept records of postoperative infections. It was also estimated that only 62% of cases of post-operative endophthalmitis were reported [4].

The eye department at the Southern General Hospital (SGH) in Glasgow has an electronic database which allows patients to be retrospectively identified based on diagnosis. This database was used to carry out a retrospective audit of the incidence and visual outcome of acute endophthalmitis after cataract surgery. It was felt that data from a single UK eye unit would complement the interpretation of the BOSU incidence rate which is widely regarded as a nationwide benchmark.

Methods

All patients treated for acute post-operative endophthalmitis at the SGH between 1st January 2000 and 31st December 2006 were identified from an electronic register. For the purposes of this audit, a clinical diagnosis of presumed endophthalmitis was defined as excessive post-operative intraocular inflammation irrespective of subsequent microbial culture results or steroid responsiveness. Only patients who developed endophthalmitis after undergoing cataract surgery as a single procedure were included. Casenotes were reviewed with specific attention to details of surgery, presentation of endophthalmitis, treatment and final visual outcome. When present, systemic comorbidities relevant to the risk of endophthalmitis were also recorded (diabetes, malignancy, immunosuppression, recurrant chest or urinary tract infections). The final visual outcome was defined as the best vision achieved after treatment and maintained over at least 2 consecutive visits 4 weeks apart.

A grading system for final visual outcome was devised based on three categories – *good* (final best corrected visual acuity (BCVA) better than pre-op BCVA and better than 6/60), *fair* (final BCVA worse than the pre-op BCVA but better than 6/60), and *poor* (final BCVA worse or equal to 6/60). The threshold of useful vision was chosen to be 6/60. To study the impact of poverty on visual outcome, post-code based Carstairs deprivation scores (CDS) were derived for each patient and converted to 3 categories – not deprived (CDS < 0), deprived ($0 \leq$ CDS < 4) and very deprived (CDS $\geq$ 4) [5].

Data on the number of cataract operations performed each year were obtained from the *Department of Audit and Clinical Effectiveness* and used to calculate annual incidence figures for post-operative endophthalmitis. All patients having had cataract surgery at the SGH would, upon developing endophthalmitis, have presented or been referred back to us for management.

An accurate determination of incidence was therefore possible within the framework of the *National Health Service (NHS).* Statistical measures of concordance for ordinal categories (Pearson's r, Spearman's rho, Somers' d, Kendall's tau-b, Goodman-Kruskall gamma) were applied to our grading system of final visual outcome and used to identify potential prognostic factors. All calculations were performed using MINITAB 14.

Results

Over the 7 year period of this retrospective consecutive series, 25 cases of post-operative endophthalmitis, meeting the inclusion criteria, were treated at the SGH. Nineteen (76%) had their cataract surgery at the SGH with the remaining 6 (24%) having theirs elsewhere. There were 15 (60%) males and 10 (40%) females with an overall mean age of 72 ± 12 years. The mean CDS was 1.2 ± 5.5. Sixteen patients (64%) had at least one relevant systemic comorbidity with 6 (24%) being diabetic. All had pre-operative skin preparation using povidone iodine. A local anaesthetic technique was employed in all but one. Twenty three (92%) patients had phacoemulsification via clear corneal incision and 2 (8%) were converted to extracapsular cataract extraction (ECCE) after attempted phacoemulsification. Surgery was uncomplicated in 21 (84%) with the remaining 4 (16%) having posterior capsular (PC) rupture and vitreous loss. All patients received post-operative chloramphenicol and prednisolone acetate drops. The mean time from surgery to presentation with endophthalmitis (PwE) was 4.2 ± 2.9 days (median 3, range 1- 14). The visual acuity at presentation was 6/60 or worse in 20 (80%) patients. Seven (28%) patients were presumed to have a low grade endophthalmitis at presentation. The presence or absence of a relative afferent papillary defect (RAPD) was documented in only 11 (44%) cases and was clearly positive in 5 (45%).

A vitreous biopsy with injection of intravitreal antibiotics was undertaken in 20 (80%) patients. A sample of aqueous from the anterior chamber (AC) was also taken in 16. Two (8%) patients, with presumed low-grade endophthalmitis, had AC samples taken only. Three (12%) patients had neither a vitreous biopsy nor an AC tap – two on account of low-grade endophthalmitis and one for medical reasons (multiple co-morbidities and general frailty). Vitreous biopsy yielded an organism in 12 (60%) patients. Growth on an appropriate culture medium was heavy in 5 (42%), moderate in 2 (17%) and light in 5 (42%). There were 7 (58%) isolates of *coagulase negative*

staphylococcus, 4 (33%) *streptococcus species* in general and 1 isolate identified only as gram positive cocci. Of the 18 AC samples, only 4 (22%) yielded an organism. The vitreous biopsy in these 4 cases was invariably positive for the same organism.

Information on the specific regime of intravitreal antibiotics was verifiable for 17 of the 20 patients. Vancomycin and amikacin were given in 7 (41%) patients whereas vancomycin-gentamicin, vancomycin-cefuroxime and cefuroxime-gentamicin combinations were given in 5 (29%), 2 (12%) and 3 (18%) patients respectively. All 25 patients in this series had intensive topical antibiotics. Eleven (44%) patients had oral steroids. A vitrectomy was undertaken in 5 (20%) patients – 3 had perception of light (PL) vision at presentation and 2 had hand movements (HM) vision.

The mean time to achieving a final visual outcome was 3.8 ± 3.4 months (range 0.5 – 13). Based on our classification, the final visual outcome was good in 16 (64%) patients, fair in 4 (16%) and poor in 5 (20%). Of those with a poor outcome, 2 patients had a comfortable eye with no perception of light and 1 required an enucleation for a blind painful eye. There was a statistically significant association between poor vision at presentation and a poor visual outcome (p=0.018). In culture-positive vitreous biopsies, *coagulase negative staphylococcus* was associated with a better final visual outcome than *streptococcus species* (p=0.01). In this series, there was no statistically significant relationship between deprivation and visual outcome (p= 0.95). Presence of systemic comorbidity (p=0.76), complicated surgery (p= 0.97), presence of RAPD (p=0.12), timing of PwE (p=0.90), positive vitreous biopsy (p=0.21), heavy growth in culture-positive vitreous biopsy (p=0.89), intravitreal antibiotic regime (p=0.20) and oral steroid use (p=0.60) were similarly not found to be statistically significant predictors of final visual outcome (table 2).

Between 1st January 2000 and 31st December 2006, 9664 cataract extractions were undertaken at the SGH. The overall incidence of endophthalmitis was 0.20% (95% confidence interval, 0.10% - 0.30%). Only cases of endophthalmitis following surgery at the SGH were included in the calculation.

Discussion

Our incidence of 0.20 % for post-operative endophthalmitis is comparable to the corrected estimate from the BOSU survey and arguably higher than other UK studies (table 3) [3, 4, 6 - 8]. This can be explained by the broad case definition applied in order to address previous concerns about under-reporting [4]. Since endophthalmitis can lead to rapid loss of vision, excessive inflammation, particularly in the early post-operative phase, should be regarded as infective endophthalmitis. In our series, 28% (7/25) patients were deemed to have an acute low grade endophthalmitis at initial presentation reflecting the difficulty in distinguishing between a predominantly inflammatory rather than infective aetiology. Microbiological investigations in these patients, when undertaken, were also negative but it is known that conventional culture techniques do not indentify all infective cases [9]. Cases of presumed acute low grade endophthalmitis, which could in retrospect be labelled as inflammatory, have, therefore, been included to provide an accurate reflection of our clinical practice.

There appears to be little regional variation in the microbiological profile of endophthalmitis in the UK. In this series, samples for microbiology were obtained in 88% (22/25) of patients and were positive in 55% (12/22). Vitreous biopsies were positive in 60% (12/20) whereas AC taps were positive in 22% (4/18) only. There was no instance of a positive AC tap with a negative vitreous biopsy in the same patient. Gram positive organisms accounted for all positive cultures with *coagulase negative staphylococci* being identified in 58% (7/12). These findings are consistent with the BOSU survey and a recent study by Mollan et al in the West Midlands (table 4) [4, 7]. Whilst the importance of an AC tap may not be apparent in this series, about 7% of patients who had both an AC tap and a vitreous biopsy in the BOSU survey and the study by Mollan et al had a positive culture from aqueous only [4, 7]. It was also observed in the BOSU survey that *pseudomonas* was cultured from aqueous but not vitreous in 60% of reported

pseudomonas isolates [4]. An AC tap can therefore be valuable in indentifying true infective cases of endophthalmitis and should be performed in all presumed cases [10]. In our series, only 72% (18/25) had AC taps. This is a possible explanation for the absence of gram negative isolates.

The vancomycin/amikacin combination of intravitreal antibiotics was the most popular choice in our series (41%) as well as the BOSU survey (55%). The use of this combination in the Endophthalmitis Vitrectomy Study (EVS) may explain its popularity [11]. Overall, 80% (20/25) of our patients received intravitreal antibiotics in comparison with 96% in the BOSU survey. Of those that did not in this series, 80% (4/5) were presumed to have a low grade endophthalmitis with 3 (60%) having a visual acuity of 6/24 or better at presentation. These patients were treated with intensive topical antibiotics and steroid and, in each case, had a final visual outcome which was deemed *good*. In the BOSU survey, 75% of patients who did not receive intravitreal antibiotics had 6/60 vision or worse. It is arguable that presumed acute low grade endophthalmitis poses a management dilemma being indistinguishable from a severe sterile uveitis and not having all the features of a full-blown aggressive infective endophthalmitis. It is also possible that some cases may represent manifestations of toxic anterior segment syndrome (TASS) [12]. To our knowledge, there are no guidelines applicable to the management of presumed acute low grade endophthalmitis. Neither the EVS nor the BOSU survey specifically alludes to this small but significant proportion of patients in whom the risks of intravitreal therapy may even outweigh the intended benefits [4, 11].

In the pre-EVS era, the importance of pars plana vitrectomy (PPV) in the management of endophthalmitis was unclear [13]. It was subsequently demonstrated that patients who present with perception of light (PL) vision benefit most from immediate vitrectomy [11, 13]. Strict inclusion criteria were used in the EVS such that the findings, it can be argued, apply to very specific

subgroups of patients[13, 14]. Over the years, indications for PPV in the management of post-operative endophthalmitis have evolved and also been subject to varied interpretations[14]. It is frequently reported that, thanks to the EVS, more patients are now managed in the office setting with vitreous tap and intravitreal antibiotics [15]. It can be inferred that the threshold for PPV varies significantly on either side of the Atlantic. The BOSU survey finding of 70% of patients with PL vision not undergoing PPV suggests that UK ophthalmologists have adapted the EVS recommendations to their local context [4]. It is possible that the difficulty in accessing a vitreoretinal service, often provided from a tertiary referral centre, may account for a much higher threshold for immediate PPV. The inclination of most UK ophthalmologists may be to try intravitreal antibiotics first. In this series, 20% (5/25) of all patients and 75% (3/4) of those who presented with PL vision had a PPV despite there not being a vitreoretinal service on-site. Since our series is more recent, it may also reflect changing attitudes amongst UK ophthalmologists.

In this series, 80% (20/25) of patients had a presenting visual acuity of 6/60 or worse and 64% (16/25) achieved driving standard vision or better after treatment. In the BOSU survey, 85% had a visual acuity of 6/60 or worse and 48% achieved driving standard vision or better [4]. We felt the need to devise a scale to grade visual outcome in order to give due consideration to pre-operative vision as this was likely to influence patient perception of visual recovery. According to this scale, the final visual outcome was better than pre-operative vision in 64% (16/25). When using an acuity of 6/60 as a threshold for functional vision, 80% (20/25) achieved this or better in this series in comparison with 66% in the BOSU survey [4]. It is difficult to attribute better visual outcome to any one variable. However, it is possible that a greater awareness of the symptoms of endophthalmitis amongst our patients is reflected in earlier presentation (95.6% within 9 days versus 95% within 18 days in the BOSU survey [4]). Earlier treatment may account for better outcome.

The EVS has shown that older age, diabetes, corneal infiltrates, PL vision, rubeosis and a ruptured PC are all independent risk factors for decreased final visual acuity [11]. It has also been shown that visual prognosis is strongly associated with the type of infecting organism [16]. Although a rigid analysis of prognostic factors for visual outcome was beyond the scope of this small series, some known trends have been replicated. Visual acuity at presentation was a statistically significant predictor of visual outcome with all patients presenting with PL vision having a *poor* outcome. In culture positive cases, infection with *streptococcus sp* was also significantly associated with *poor* outcome. It is argued that the recommendations of the EVS do not apply to streptococcal endophthalmitis for which an immediate vitrectomy, irrespective of vision, is beneficial [10]. This may explain our observation of visual outcome in the 4 patients with streptococcal endophthalmitis – there were 3 *poor* outcomes without vitrectomy and one *good* outcome after early vitrectomy. In this analysis, a link between visual outcome and socioeconomic deprivation was postulated. The CDS has been shown to correlate with prevalence of smoking, diabetes, obesity and vascular disease and may be regarded as a surrogate marker of systemic comorbidities [17]. Whilst no statistically significant relationship was identified in our small series, the concept of deprivation influencing visual outcome may benefit from further analysis in the context of a nationwide survey.

There are intrinsic limitations to a retrospective series such as this. The possibility that patients with endophthalmitis after surgery in our unit may have been missed on account of moving or seeking treatment elsewhere is unlikely but remains a theoretical limitation. Timing of presentation was not specifically defined for inclusion in this series. Despite this, there is a notable absence of late-onset cases. This limits our analysis to acute early-onset endophthalmitis only. Reliable statistical analysis is also precluded by small numbers. For instance, RAPD at presentation was not found to be a statistically significant predictor of visual

outcome. However, there appears to be a trend towards significance and this important sign should be recorded in all cases.

In summary, the incidence of endophthalmitis after cataract surgery in this audit from a Scottish unit compares well with the current accepted UK benchmark [4]. The microbiological profile of endophthalmitis also appears to be very similar to the rest of the UK with the majority of culture positive cases being caused by coagulase negative staphylococci [4, 7]. Although visual recovery after endophthalmitis can be slow and variable, current treatment strategies will result in a significant proportion of patients regaining functional vision [4]. Evidence-based approaches to prophylaxis of endophthalmitis will result in a significant reduction in its incidence over the next few years. The ESCRS multicenter study has shown a five-fold reduction from the routine use of intracameral cefuroxime at the end of cataract surgery [18]. Published figures suggest that none of the 214 patients with endophthalmitis in the 1999 BOSU cohort had had intracameral antibiotics and, even in 2005, only 15% of eye departments in the UK were using this method of prophylaxis routinely [19, 20]. Whilst these figures seem to suggest a reluctance to introduce intracameral antibiotics, they predate the 2007 ESCRS findings [18]. The ESCRS findings are poised to influence surgical practice in the UK and elsewhere and are already being replicated [21]. The importance of continuous surveillance and audit cannot be over-emphasized with respect to indentifying trends in post-operative endophthalmitis within individual eye units.

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Table 1 – Patient characteristics (*italics* identify those with presumed low grade endophthalmitis*)*

			Tap			BCVA				
Patient	**Details**	**PwE (days)**	**Vitreous**	**AC**	**Organism**	**Pre-op**	**PwE**	**Final**	**Time to final BCVA**	**Outcome**
1	F, 85, LE	5	Y++	Y++	gram +ve cocci	6/12	HM	6/18	N/A	Fair
2	M, 66, RE	3	Y-	Y-	Nil identified	6/12	HM	6/9	9 months	Good
3	M, 85, LE	3	N	N	-	HM	PL	NPL	6 months	Poor
4	F, 84, RE	6	Y-	Y-	Nil identified	CF	HM	CF	5 months	Poor
5	***F, 78, RE***	*3*	*N*	*N*	-	*6/18*	*CF*	*6/12*	*2 weeks*	*Good*
6	***M, 84, LE***	*1*	*Y-*	*Y-*	*Nil identified*	*6/18*	*6/36*	*6/12*	*4 months*	*Good*
7	***M,65, LE***	*5*	*Y-*	*Y-*	*Nil identified*	*6/12*	*6/24*	*6/12*	*4 months*	*Good*
8	M, 69, LE	2	Y+++	Y+	strep oralis	6/36	PL	NPL	2 weeks	Poor
9	***F, 77, RE***	*2*	*Y-*	*Y-*	*Nil identified*	*6/9*	*6/60*	*6/12*	*2 weeks*	*Fair*
10	M, 74,LE	5	Y+	Y-	coag –ve staph	N/A	HM	6/9	4 weeks	Good
11	F, 72, RE	9	Y+	Y-	coag –ve staph	6/9	HM	6/6	N/A	Good
12	M, 60, RE	6	Y+	Y-	coag –ve staph	6/6	CF	6/9	2 weeks	Fair
13	M, 49, LE	4	Y+	Y+	α haemolytic strep	6/18	HM	6/6	3 months	Good
14	F, 73, LE	7	Y+++	N	coag –ve staph	6/12	HM	6/9	13 months	Good
15	F, 62, LE	7	Y-	Y-	Nil identified	HM	HM	6/6	3 months	Good
16	M, 67, RE	3	Y+++	N	coag –ve staph	6/24	CF	6/24	N/A	Good
17	F, 86, LE	4	Y+	N	coag –ve staph	6/24	HM	6/9	5 months	Good
18	M, 88, LE	2	Y+++	Y-	strep salivarius	6/12	PL	Enucleation	4 months	Poor
19	M, 64, LE	1	Y+++	Y+	strep salivarius	6/60	PL	CF	4 months	Poor
20	M, 84, LE	3	Y-	Y-	Nil identified	6/18	HM	6/9	6 months	Good
21	***F, 87, RE***	*14*	*N*	*N*	-	*6/18*	*6/24*	*6/18*	*4 weeks*	*Good*
22	M, 50, LE	3	Y-	Y-	Nil identified	6/60	CF	6/24	2 months	Good
23	***M, 80, LE***	*1*	*N*	*Y-*	*Nil identified*	*6/6*	*6/18*	*6/12*	*1 month*	*Fair*
24	M, 67, RE	5	Y++	N	coag –ve staph	6/9	CF	6/9	10 months	Good
25	***M, 60, LE***	*1*	*N*	*Y-*	*Nil identified*	*PL*	*6/9*	*6/6*	*1 month*	*Good*

(M=male, F=female; RE= Right eye, LE=Left eye; Y= Yes, N=No; Growth + = light, ++ = moderare , +++=heavy; CF= counting fingers, HM= hand movements, PL= perception of light)

Table 2 – Prognostic factors of visual outcome

	Good (%)	Fair (%)	Poor (%)	Significance of association
Vision				
≥6 /60	4 (16)	2 (8)	0	*p= 0.018*
CF	4 (16)	1 (4)	0	
HM	8 (32)	1 (4)	1 (4)	
PL	0	0	4 (16)	
Deprivation				
Not deprived	6 (24)	4 (16)	3 (12)	*p=0.95*
Deprived	3 (12)	0	1 (4)	
Very deprived	7 (28)	0	1 (4)	
Comorbidity				
Present	9 (36)	2(8)	4 (16)	*p=0.76*
Absent	7 (28)	2(8)	1 (4)	
Surgery				
Complicated	1 (4)	1 (4)	2 (8)	*p=0.97*
Routine	15 (60)	3 (12)	3 (12)	
PwE				
≤3 days	7(28)	2(8)	4(16)	*p=0.90*
>3 days	9(36)	2(8)	1(4)	
RAPD				
Present	4 (36)	0	1 (9)	*p =0.12*
Absent	6 (55)	0	0	
Vitreous biopsy				
Positive	7 (35)	2 (10)	3 (15)	*p =0.21*
Negative	6 (30)	1 (5)	1 (5)	
Growth				
Heavy	2 (17)	0	3 (25)	*p =0.89*
Medium	1 (8)	1 (8)	0	
Light	4 (33)	1 (8)	0	
Organism				
Coagulase negative staph	6 (55)	1 (9)	0	*p =0.01*
Streptococcus sp	1 (9)	0	3 (27)	
Intravitreal regime				
Vancomycin-Amikacin	4 (24)	1 (6)	2 (12)	*p =0.20*
Vancomycin-Gentamicin	3 (18)	1 (6)	1 (6)	
Vancomycin-Cefuroxime	1 (6)	0	1 (6)	
Cefuroxime-Genatmicin	3 (18)	0	0	
Oral steroids				
Used	9 (36)	2 (8)	1 (4)	*p =0.60*
Not used	7 (28)	2 (8)	4 (16)	

Table 3 – UK incidence of endophthalmitis

Authors	Year	Cohort	Incidence
Desai et al [3]	1997-1998	UK NCCS	0.03%*
Kamalarajah et al [4]	1999-2000	BOSU	0.14%
Mayer et al [6]	1991-2001	Taunton	0.16%
Mollan et al [7]	1997-2004	West-Midlands	0.099%
Zaidi et al [8]	2002-2004	London	0.1%
This study	2000-2006	Glasgow	0.2%

(* incidence within 48hrs of surgery)

Table 4 – The microbiological profile of endophthalmitis from UK studies

	This study	Kamalrajah et al[4]	Mollan et al [7]	Mayer et al [6]
Microbiological samples	88 % (22/25)	93% (199/213)	100% (105/105)	87% (26/30)
Positive vitreous biopsy	60% (12/20)	53% (97/182)	53% (55/103)	N/A
Positive AC tap	22% (4/18)	29% (36/126)	26%(26/101)	N/A
Culture positive cases	55% (12/22)	56% (111/199)	58%(61/105)	52% (14/26)
Gram positive isolates	100% (12/12)	93%(103/111)	93%(57/61)	76% (10/14)
Coagulase negative staph	58% (7/12)	49%(54/111)	62%(38/61)	57% (8/14)
Streptococcus sp	33% (4/12)	32%(36/111)	20%(12/61)	14% (2/14)

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Competing Interest

None declared