National cataract surgery survey 1997–8: a report of the results of the clinical outcomes

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Abstract

Aims—A national survey of over 100 hospitals in the UK was carried out to collect routine clinical information on the outcomes of cataract surgery. The clinical outcomes of interest were: visual acuity at time of discharge from postoperative hospital follow up, visual acuity at time of final refraction; complications related to surgery occurring during the operation, within 48 hours of surgery, and within 3 months of surgery. In addition, information on age and comorbidity was obtained. This article reports on the findings of the experience of approximately 18 000 patients who had cataract surgery in the hospital eye service of the NHS.

Results—Of those with no ocular comorbidity, 85% achieved a visual acuity of 6/12 or better on discharge from postoperative hospital follow up, while 65% of patients with a serious co-existing eye disease achieved this level of acuity at this time. At final refraction, 92% of patients without ocular comorbidity and 77% of patients with ocular comorbidity achieved 6/12 or better visual acuity. The following main risk indicators were associated with visual outcomes and complications related to surgery: age, other eye diseases, diabetes and stroke, type of surgical procedure, and grade of surgeon.

Conclusions—The acceptability of these findings could fruitfully be the subject of discussion within the ophthalmic community and hopefully issues arising out of the study can lead to research, especially in-depth studies of the outcomes of cataract surgery in those patients with co-existing serious eye conditions.

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By the next millennium we may reach 200 000 as the annual number of cataract operations performed within the NHS. The need for a programme of research into the outcomes of this common surgical procedure has been recognised for some time.[1] This recently completed study had as its objective the provision of baseline information on patient profiling[2] and the application of epidemiological method to specifically collected, large scale, routine clinical information on the outcomes of cataract surgery. Within this study particular attention was paid to age, comorbidity, visual acuity, and complications of surgery. This article reports on the findings of the experience of approximately 18 000 patients who had cata-

ract surgery in the hospital eye service of the National Health Service (NHS).

Method

As described elsewhere[2] and summarised here, more than 100 unselected hospital eye units within the UK agreed to collect data on patients undergoing cataract surgery according to a predefined set of preoperative and postoperative forms. Data were collected on patients undergoing cataract extraction between September and December of 1997 and for a period up to 3 months after surgery. Preoperative data were collected prospectively and postoperative data were collected both prospectively and retrospectively.

The data collection forms were developed by a team that included ophthalmologists and epidemiologists. A handbook of instructions for data collection and recording was prepared to complement the standardised forms. This was to help ensure a standard method of data extraction and recording. The forms were tested through pilot studies. The work in each unit was carried out under the auspices of the ophthalmic clinical director. The recording of data was devolved to varying degrees to clinical audit staff and community optometrists were requested to return information on visual acuity on patients who presented within 3 months of surgery.

The clinical outcomes of interest were Snellen visual acuity after surgery (with correction if worn, or with pinhole) and complications related to surgery.

Visual outcomes for cataract surgery are reported as the achievement of a defined level of Snellen acuity (6/12 or better in the surgery eye) at two points in time during the postoperative recovery process: at time of discharge from follow up in hospital and at final refraction performed within 3 months of surgery. These represent key stages in patients' postoperative clinical recovery. In addition, at final refraction when recovery is expected to have stabilised, a more stringent visual outcome of achieving Snellen acuity of 6/9 or better (in the operated eye) is also reported.

The complications of surgery of interest were those clinically evident events which occurred during the operation, within 48 hours of surgery, or within 3 months of surgery. Having noted from a survey of practice the shorter postoperative follow up periods in eye clinics,[3] the complications considered within 3 months of surgery were only those which were sight threatening events necessitating a hospital clinical assessment and further management. These were clinically evident endophthalmitis

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Table 1 Variables included in analyses for risk indicators of poor clinical outcome

Variables and their categories	
Age (years)	
50 to 59	referent group
60 to 69	
70 to 79	
80 to 89	
90 and over	
Sex	
male	referent group
female	
Ocular comorbidity*	
absent	referent group
present	
Diabetes mellitus	
absent	referent group
present	
Stroke	
absent	referent group
present	
Surgical procedure	
Phacoemulsification	referent group
Extracapsular extraction	
Grade of surgeon	
Consultant	referent group
Specialist registrar	
Senior house officer	
Associate specialist	
Other	
"Capsule rupture and vitreous loss during the operation"†	
absent	referent group
present	

*Includes age related macular degeneration, glaucoma, diabetic retinopathy, amblyopia.
†Only included in analysis for endophthalmitis and retinal detachment/tear.

Table 2 Availability of follow up data within 3 months of surgery

	Follow up data within 3 months of surgery	
	Not available (%)	Available (%)
(A) Patient characteristics:		
1 Age group		
50–54	64 (2)	307 (2)
55–59	104 (4)	570 (4)
60–64	155 (6)	914 (6)
65–69	282 (10)	1 591 (10)
70–74	414 (15)	2 579 (16)
75–79	555 (21)	3 595 (23)
80–84	578 (22)	3 256 (21)
85+	526 (20)	2 964 (19)
2 Sex		
Female	1 735 (65)	10 303 (65)
Male	943 (35)	5 473 (35)
3 Visual acuity on admission		
6/6 to 6/12	478 (22)	3 851 (28)
6/18 to 6/60	1 169 (55)	7 110 (51)
less than 6/60	483 (23)	2 941 (21)
4 Ocular comorbidity		
Absent	1 967 (73)	11 328 (72)
Present	711 (27)	4 448 (28)
5 Diabetes mellitus		
Absent	2 361 (88)	14 031 (89)
Present	317 (12)	1 745 (11)
6 History of stroke		
Yes	2 581 (96)	15 029 (95)
No	97 (4)	747 (5)
(B) Surgery characteristics:		
1 Surgical procedure		
Phacoemulsification	2 097 (80)	12 013 (77)
ECCE	507 (20)	3 688 (23)
2 Grade of surgeon		
Consultant	1 509 (57)	10 131 (64)
Specialist registrar	509 (19)	2 415 (15)
Senior house officer	199 (8)	971 (6)
Associate specialist	123 (5)	1 116 (7)
Other	293 (11)	1 087 (7)
3 "Capsule rupture and vitreous loss"		
Absent	2 556 (95)	15 081 (96)
Present	122 (5)	695 (4)

and retinal detachment or retinal tear. No differentiation was made between sterile and culture proved endophthalmitis.

A specially designed computer database application was used for entry, validation, and preparation of the data for analysis and the SPSS software was used for data analysis. Multiple logistic regression analysis was employed to identify risk indicators for the following poor clinical outcomes: visual outcome at discharge from postoperative hospital follow up; surgically related complications occurring within 48 hours of surgery; endophthalmitis within 3 months of surgery; retinal detachment or tear within 3 months of surgery. The candidate variables (potential risk indicators, confounders, and effect modifiers) used in the analyses are shown in Table 1. Before multiple logistic regression, a comprehensive set of analyses were performed to assess crude odds ratios for each variable without adjustment for confounding, followed by stratified data analysis to identify major effect modification and/or confounding. Detailed cross tabulations were made to explore interrelations between the potential risk indicators, and in particular, to identify extreme correlation. The strategy used for the multiple logistic regression was based on the methods described by Kleinbaum et al.[4] The main findings from the regression analysis are reported, and estimates for the risk of a poor outcome (presented as odds ratios) are provided having adjusted for the effect of all other variables in the regression models.

Results
Data on 18 454 patients of 50 years of age and more were available for analysis; 77% of these patients had surgery performed by phacoemul-

sification. Follow up data within 3 months of surgery were available for 15 787 patients. As shown in Table 2, there were no important differences between patients with and without follow up data within 3 months of surgery in terms of the patient and surgery characteristics that were used in the subsequent data analysis and regression models.

Visual acuity data before and after surgery were available for 14 528 patients. Of these patients 8526 (58.7%) had no ocular comorbidity (age related macular degeneration, glaucoma, diabetic retinopathy, amblyopia). Information on 8872 patients was available at time of final refraction, and of these 5312 (59.9%) were free from other serious eye conditions.

VISUAL ACUITY OUTCOME
At time of discharge from postoperative hospital follow up
Seventy seven per cent of all patients achieved visual acuity of 6/12 or better, 20% achieved a visual acuity of 6/18 to 6/60, and 3% had a visual outcome of less than 6/60 at this time (Table 3).

Eighty five per cent of patients with no ocular comorbidity achieved a visual acuity of 6/12 or better, while 65% of patients with ocular comorbidity achieved this level of visual outcome at discharge from hospital follow up (Table 4).

Table 3 Visual acuity outcome by age: at discharge from postoperative hospital follow up

Age group (years)	Visual acuity (row (%))		
	6/12 or better	6/18 to 6/60	less than 6/60
50–54	239 (84)	38 (13)	8 (3)
55–59	449 (85)	64 (12)	14 (3)
60–64	696 (83)	123 (15)	15 (2)
65–69	1 193 (83)	220 (15)	30 (2)
70–74	1 943 (82)	371 (16)	50 (2)
75–79	2 672 (81)	584 (17)	61 (2)
80–84	2 207 (73)	668 (22)	135 (5)
85–89	1 361 (67)	548 (27)	126 (6)
90+	383 (54)	258 (36)	72 (10)
All ages	11 143 (77)	2 874 (20)	511 (3)

Number of patients with incomplete data (excluded from this table) = 1259.

Age was related to the level of visual acuity achieved after surgery, younger patients having better outcomes (Table 3).

At time of final refraction
Eighty six per cent (85.7%) of all patients achieved a visual acuity of 6/12 or better at this time; 12% of patients achieved acuity of 6/18 to 6/60, and 2% had a visual outcome of less than 6/60 at final refraction.

Ninety two per cent (91.7%) of patients with no ocular comorbidity achieved 6/12 or better acuity at final refraction compared which 77% of patients with ocular comorbidity (Table 5).

Using a more stringent level of visual acuity outcome of 6/9 or better at this time, then 73% of all patients achieved this level of visual acu-

ity. Seventy six per cent of patients having a phacoemulsification procedure achieved 6/9 or better visual acuity, while 63% of patients having an extracapsular cataract extraction (ECCE) achieved this level of acuity at final refraction.

Eighty per cent of all patients without ocular comorbidity achieved 6/9 or better at final refraction. Of this group of patients without ocular comorbidity, 82% of patients having a phacoemulsification procedure achieved this level of visual acuity while 72% of patients having an ECCE procedure achieved this 6/9 or better acuity at final refraction. Similarly, 61% of all patients with ocular comorbidity achieved 6/9 or better visual acuity at final refraction. Of this group, 65% of patients having a phacoemulsification procedure achieved this level of acuity and 47% of patients having an ECCE procedure achieved 6/9 or better visual acuity at final refraction.

Visual outcome by specific comorbid ocular conditions
Visual outcomes in patients with specific comorbid ocular conditions are presented in Tables 4 and 5. At discharge from postoperative hospital follow up a visual acuity of 6/12 or better was achieved in 67% (1125/1688) of patients with glaucoma, in 59% (1525/2577) of patients with age related macular disease, in 56% (264/476) of patients with diabetic retinopathy and in half (50%, 104/206) of the patients with amblyopia (Table 4).

At time of final refraction, the proportion of patients achieving a good visual outcome were higher for each of these comorbid conditions (Table 5). Seventy seven per cent of patients with glaucoma (717/927) and 72% (1138/1575) of patients with age related macular disease achieved visual acuity of 6/12 or better at this time. About two thirds of patients with diabetic retinopathy (68%, 179/265) and amblyopia (67%, 88/131) had a good visual outcome at final refraction.

Table 4 Visual acuity outcome by ocular comorbidity: at discharge from postoperative hospital follow up

Ocular comorbidity	Visual acuity (row (%))			
	6/12 or better	6/18 to 6/60	less than 6/60	Total
Age related macular disease				
present	1 525 (59)	799 (31)	253 (10)	2 577
absent	9 618 (81)	2 075 (17)	258 (2)	11 951
Glaucoma				
present	1 125 (67)	434 (26)	129 (7)	1 688
absent	10 018 (78)	2 440 (19)	382 (3)	12 840
Diabetic retinopathy				
present	264 (56)	172 (36)	40 (8)	476
absent	10 879 (78)	2 702 (19)	471 (3)	14 052
Amblyopia				
present	104 (50)	86 (42)	16 (8)	206
absent	11 039 (77)	2 788 (20)	495 (3)	14 322
Any ocular comorbidity				
present	3 902 (65)	1 675 (28)	425 (7)	6 002
absent	7 241 (85)	1 199 (14)	86 (1)	8 526

Number of patients with incomplete data (excluded from the table) = 1259.

Table 5 Visual acuity outcome by ocular comorbidity: at final refraction

Ocular comorbidity	Visual acuity (row (%))			
	6/12 or better	6/18 to 6/60	less than 6/60	Total
Age related macular disease				
present	1 138 (72)	344 (22)	93 (6)	1 575
absent	6 462 (89)	751 (10)	84 (1)	7 297
Glaucoma				
present	717 (77)	178 (19)	32 (4)	927
absent	6 883 (87)	917 (11)	145 (2)	7 945
Diabetic retinopathy				
present	179 (68)	74 (28)	12 (4)	265
absent	7 421 (86)	1 021 (12)	165 (2)	8 607
Amblyopia				
present	88 (67)	38 (29)	5 (4)	131
absent	7 512 (86)	1 057 (12)	172 (2)	8 741
Any ocular comorbidity				
present	2 731 (77)	686 (19)	143 (4)	3 560
absent	4 869 (92)	409 (7)	34 (1)	8 526

Number of patients with incomplete data (excluded from the table) = 3701.

Risk indicators for poor visual outcome (less than 6/12) at discharge from postoperative hospital follow up—main findings
The results of the multiple logistic regression analysis showed that older age was associated with higher risk, the oldest age group (90 years and over) having four times higher risk of poor visual outcome at this time compared with the youngest group (50–59 years). The 95% confidence limits for this odds ratio were 3.1 to 5.1.

The presence of ocular comorbidity was also associated with a higher risk (odds ratio 2.7, 95% CI 2.5 to 2.9).

Patients with diabetes mellitus or stroke were less likely to achieve a "good" outcome having odds ratios of 1.6 (95% CI 1.4 to 1.8) and 1.3 (95% CI 1.1 to 1.6) respectively.

Patients having an ECCE were twice as likely to fail to achieve 6/12 or better at time of discharge from hospital follow up (odds ratio phacoemulsification/ECCE = 0.5, 95% CI 0.4 to 0.5)

Table 6 Events occurring during surgery (n=18 472 patients)

Event	Frequency No (%)
Anterior chamber haemorrhage	85 (0.5)
Anterior chamber collapse	98 (0.5)
Torn iris	76 (0.4)
Iris emulsification	63 (0.3)
Persistent iris prolapse	136 (0.07)
Choroidal haemorrhage	13 (0.1)
Capsule rupture and vitreous loss	818 (4.4)
Incomplete cortical clean up	192 (1.0)
Loss of nuclear fragment into vitreous	51 (0.3)
Loss of intraocular lens into vitreous	11 (0.16)
Torn Descemet's membrane	21 (0.1)
Abnormality in wound closure	26 (0.1)
Any of the above events	1 388 (7.5)

Table 7 Events occurring within 48 hours of surgery (n=17 257 patients)

Event	Frequency No (%)
Raised intraocular pressure	1 356 (7.9)
Periocular bruising more than expected	173 (1)
Periocular oedema more than expected	76 (0.4)
External eye infection	11 (0.06)
Wound leak/rupture	212 (1.2)
Vitreous to section	52 (0.3)
Corneal oedema	1 646 (9.5)
Hyphaema	195 (1.1)
Hypopoyon	3 (0.02)
Uveitis	972 (5.6)
Iris abnormality	158 (0.9)
Pupil block	5 (0.03)
Capsule opacity	64 (0.4)
Retained lens material	196 (1.1)
Intraocular lens dislocation	25 (0.1)
Cystoid macular oedema	8 (0.05)
Retinal tear	4 (0.02)
Retinal detachment	6 (0.03)
Choroiditis	1 (0.006)
Optic neuropathy	1 (0.006)
Endophthalmitis	5 (0.03)
Any of the above	4 021 (23.3)

COMPLICATIONS RELATED TO SURGERY

Events occurring during the operation

Overall, 7.5% of patients experienced one or more of the range of events shown in Table 6. The most frequently occurring event was capsule rupture and vitreous loss which occurred in 4.4% of patients. There was no appreciable difference observed by type of surgical procedure (4.3% for phacoemulsification and 4.8% for ECCE).

Events occurring within 48 hours of surgery

During this early postoperative period 23.3% of all patients had one or more of the complications presented in Table 7. These ranged from minor to potentially sight threatening events. The most frequently recorded events were corneal oedema (9.5%), raised intraocular pressure (7.9%), and uveitis (5.6%). These occurred with similar frequency for both phacoemulsification and extracapsular extraction.

Risk indicators for complications within 48 hours of surgery—main findings

A trend of increasing risk with age was observed, the oldest age group (90 years and over) having 1.6 times the risk of a complication within this early postoperative period compared with the youngest group (50–59 years). The presence of ocular comorbidity was significantly associated with a surgically related complication at this time having an odds ratio 1.2 (95% CI 1.1 to 1.3). Having the operation performed by a surgeon in the senior house officer grade was also associated with higher frequency of complications (compared with consultant grade) in this postoperative period (odds ratio 1.6, 95% CI 1.4 to 1.8).

WITHIN 3 MONTHS OF SURGERY

In the 15 787 patients for whom follow up data were available there were 26 cases of endophthalmitis within 3 months of surgery (0.1%, 95% CI 0.1% to 0.2%). At discharge from hospital follow up, over half (54%) of these patients achieved a visual acuity of 6/12 or better, 27% of patients had visual acuity of 6/18 to 6/60, and 19% of patients had acuity less than 6/60.

There were 26/15 787 cases of retinal detachment or tear within 3 months of cataract extraction (0.1%, 95% CI 0.1% to 0.2%). By the time of discharge from hospital follow up, 30.5% of these patients achieved a visual acuity of 6/12 or better, 30.5% achieved 6/18 to 6/60, and the 39% of patients had less than 6/60 visual acuity.

Risk indicators for endophthalmitis—main findings

Multiple logistic regression showed that the occurrence of "capsule rupture and vitreous loss" during the operation had an eightfold higher risk of endophthalmitis (odds ratio 7.9, (95% CI 3.5 to 17.9) compared with the absence of this event during surgery.

Risk indicators for retinal detachment or tear—main findings

"Capsule rupture and vitreous loss" during the operation increased the risk of retinal detachment or tear within 3 months of cataract extraction 10-fold (odds ration 10.3, 95% CI 4.4 to 23.9). Serious co-existing ocular conditions were also observed to be associated with a risk of retinal detachment or tear within 3 months of surgery (odds ratio 2.3) but this was of borderline significance (95% CI 1.03 to 5.1).

Discussion

National estimates for the clinical outcomes of cataract surgery have been provided by this large dataset. In doing so we favoured a methodological approach which took the key stages of recovery for assessment of outcomes rather than a fixed calendar time of follow up.

We have shown that good visual outcomes are achieved nationally for most cataract patients particularly in patients without ocular comorbidity and in the relatively "young" elderly. At the very poor outcome end of the spectrum 1% of patients without ocular comorbidity achieved visual acuity less than 6/60 at discharge from postoperative hospital follow up. While these findings represent the "national average" for present performance, the representatives of the ophthalmological community must decide if this can be improved upon.

Given that almost 80% of the patients are 70 years of age and over,[2] and that about 40% of all patients have ocular comorbidity, our findings on these two factors are offered here to the clinical and scientific community for consideration at national and local level:

- Older age itself was associated with poor visual outcome after adjusting for presence of age related co-existing eye disorders such as age related macular disease
- Ocular comorbidity, diabetes, or stroke were significant risk factors for poor clinical outcome (visual acuity and complications within 48 hours of surgery), after adjusting for the confounding effect of age and other factors in the model shown in Table 1.

This study has demonstrated a definitive strong relation between capsule rupture and vitreous loss and the risk of endophthalmitis, and of retinal detachment or tear within 3 months of cataract surgery.

While it is unlikely that a study of this size can be repeated more than every 10 years, it is possible for smaller in-depth studies to take forward some of the issues raised. At least three important issues arise in relation to outcome of cataract surgery: timing of assessment of outcome, ongoing research into vision and aging, and the need for further study comparing outcomes in specific comorbid groups.

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