Cataract patients in a defined Swedish population 1986–90: VII Inpatient and outpatient standardised mortality ratios

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Abstract

Aims—Cataract surgery has at times been said to correlate with an increased death risk. We have therefore analysed the standardised death ratio in a population based cohort of patients that had undergone cataract surgery.

Methods—Data for all patients undergoing cataract surgery from 1986 up to and including 1990 in the Lund Health Care District were prospectively recorded, and 5120 were retrieved for analysis. Death dates and primary death diagnoses for each patient were obtained from the Swedish Bureau of Census up to and including 1991. Standardised mortality ratios were calculated for all patients, subdivided into a number of categories: inpatients, outpatients, sex, age <75 years, age ≥75 years, patients with heart and circulatory diseases, with malignant tumours, and with diabetes. The cut off age was set at 74 because this divided the patients into two approximately equal groups. Using time dependent survival regression, the relative risk for dying were estimated for sex, age, and for postoperative YAG laser capsulotomy, and also for diabetic patients and patients with rheumatoid arthritis.

Results—Inpatients almost always show an increased standardised mortality ratio compared with outpatients. Young patients and diabetic patients also showed an increased standardised mortality ratio, compared with the normal population, but not older patients, who constitute the majority. Cardiovascular death diagnoses were overrepresented among the young.

Conclusions—Cataract surgery is correlated with an increased standardised mortality ratio only in young patients and in patients with certain complicating diseases like diabetes and cardiovascular diseases.

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and there are studies in which no correlation has been found. Cvetkovic *et al*⁶ compared 197 cataract patients in Belgrade with close relatives or spouses, and found no increased mortality risk. In 2000 individuals in the Framingham study⁷ a relation of lens changes to survival appeared in diabetic patients only. In a nationwide study, the 5 year mortality rate figures of Medicare beneficiaries suggest that only in the relatively young patients is there an association between cataract and increased mortality risk.⁸ In the recent Beaver Dam Eye study,⁹ cataract surgery was linked to a decreased survival in the primary figures, but the linkage disappeared when correcting for age and sex. The statistical significance of the association dropped to $p=0.07$.

Because of the conflicting information in the available literature, we have analysed the mortality in a population based cohort of 5120 patients who had undergone cataract surgery and compared the observed number of deaths with the expected figures in the population, expressed as the standardised mortality ratio. We find that only relatively young cataract patients have an increased standardised mortality. We have also analysed the causes of death and found that cardiovascular diseases are overrepresented as the primary death diagnosis of the relatively young patients.

Patients and methods

The material comprises all patients who had undergone cataract surgery at the Department of Ophthalmology Lund University Hospital from 1986 to 1990. Details have been presented elsewhere¹⁰ and represent essentially all the cataract operations performed in a population of about 380 000 inhabitants. The comprehensive Swedish census system can provide detailed and precise information about the average death rates and the death diagnoses.

Outpatient cataract surgery was started in 1986, and comprised about 30% in the first year, increasing to about 60% in 1990.¹⁰ Good general health, access to good physical home support, and travel distances were factors considered when selecting patients for ambulatory surgery. An accompanying person (friend or relative) was also required for ambulatory surgery. One eyed patients and patients with complicating eye diseases were usually treated as inpatients.

Data for the cataract surgery patients were prospectively collected in a special cataract data base (CAS; Ninn-Pedersen *et al*¹⁰), from which the figures presented here were

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A number of studies have presented statistical evidence that patients operated on for cataract tend to have a shortened life expectancy.^{1–5} Since an increasing number of lens opacities can be regarded as part of the normal aging process, it is usually suggested that their growth, to such a degree that vision is hampered, reflects the presence of systemic factors that also tend to abbreviate the life of the patient. However, no such factors have been convincingly identified,

Table 1 Standardised mortality ratio (SMR) in all non-diabetic cataract patients

Age (years)	Inpatients		Outpatients		All	
	45-74	75+	45-74	75+	45-74	75+
Deaths in women:						
Observed	27	362	18	103	45	465
Expected	15.43	372.72	18.11	169.36	33.54	542.08
SMR	1.75	0.97	0.99	0.61	1.34	0.86
p Value	<0.005	>0.5	>0.5	<0.0001	0.048	<0.001
Deaths in men:						
Observed	31	189	29	95	60	284
Expected	19.69	193.42	27.71	110.34	47.40	303.76
SMR	1.57	0.98	1.05	0.86	1.27	0.93
p Value	<0.011	>0.5	>0.5	0.14	0.067	0.26
Deaths in both sexes:						
Observed	58	551	47	198	105	749
Expected	35.12	566.14	45.82	279.70	80.94	845.84
SMR	1.65	0.97	1.03	0.71	1.30	0.89
p Value	<0.001	>0.5	>0.5	<0.0001	0.0075	<0.001

The p values indicate significance of difference when compared with the normal population.

obtained. Up to 31 December 1991, 1002 patients had died according to figures obtained from the Statistiska Centralbyrån (the Swedish Bureau of Census). The material comprises patients operated on from age 15 and older, but no patient younger than 45 years has died, and this age is therefore used as the lower limit in the tables.

The primary death diagnosis was also obtained from the Swedish Bureau of Census for each of these patients. Two special groups were particularly considered: (1) heart and circulatory diseases (WHO ICD9 codes 390 to 458) and (2) malignant tumours (WHO ICD9 codes 140 to 209). In addition, all patients were analysed as a single group. The effect of diabetes at surgery was also analysed.

Table 2 Standardised mortality ratio (SMR) in all patients with diabetic cataract patients

Age (years)	Inpatients		Outpatients		All	
	45-74	75+	45-74	75+	45-74	75+
Deaths in women:						
Observed	11	54	1	12	12	66
Expected	1.94	31.40	1.11	11.64	3.05	43.04
SMR	5.67	1.72	0.90	1.03	3.93	1.53
p Value	<0.0001	<0.0001	-	>0.5	<0.0001	<0.001
Deaths in men:						
Observed	9	37	8	16	17	53
Expected	2.20	15.86	4.00	13.71	6.20	29.57
SMR	4.09	2.33	2.00	1.17	2.74	1.80
p Value	<0.0001	<0.0001	0.046	>0.5	<0.0001	<0.0001
Deaths in both sexes:						
Observed	20	91	9	28	29	119
Expected	4.14	47.26	5.11	25.35	9.25	72.61
SMR	4.83	1.93	1.76	1.10	3.14	1.64
p Value	<0.0001	<0.0001	<0.1	>0.5	<0.0001	<0.001

The p values indicate significance of difference when compared with the normal population.

Table 3 Standardised mortality ratio (SMR) in patients with non-diabetic cataract and diagnoses of cancer death

Age (years)	Inpatients		Outpatients		All	
	45-74	75+	45-74	75+	45-74	75+
Deaths in women:						
Observed	6	47	7	21	13	68
Expected	6.22	47.86	7.50	24.85	13.72	72.71
SMR	0.96	0.98	0.93	0.85	0.95	0.94
p Value	>0.5	>0.5	>0.5	0.44	>0.5	>0.5
Deaths in men:						
Observed	7	32	9	19	16	48
Expected	5.95	33.64	8.40	21.29	14.35	54.93
SMR	1.18	0.95	1.07	0.89	1.11	0.87
p Value	>0.5	>0.5	>0.5	>0.5	>0.5	0.35
Deaths in both sexes:						
Observed	13	79	16	40	29	116
Expected	12.17	81.50	15.90	46.14	28.07	127.64
SMR	1.07	0.97	1.01	0.87	1.03	0.91
p Value	>0.5	>0.5	>0.5	0.37	>0.5	0.30

The p values indicate significance of difference when compared with the normal population.

Trauma, poisoning, and gastrointestinal death diagnosed cases were also examined, but turned out to be too few to make it relevant to analyse them as separate groups.

Six cases out of the total of 5878 surgeries that were recorded did not have a social security number that could be matched with any known number at the Bureau of Census and were therefore not included in the figures. Further, 752 operations were known to be on the patient's second eye, and were therefore excluded. In all, the material comprised data from 5120 patients.

Statistical analyses were made with Fisher's exact test, Rao's score statistics,¹¹ and Cox's regression for life tables.¹²

Results

The standardised mortality ratio (SMR) is used to present the results obtained. In any given group of persons, it represents the observed number of deaths divided by the expected number.

Table 1 shows that among inpatients, the standardised mortality is increased in both young women ($p<0.005$) and young men ($p=0.011$; young is defined here as less than or equal to 74 years old). In contrast, female and male inpatients above or equal to 75 years old do not show any such increase. Among outpatients, the young patients do not have any increased standardised mortality. On the other hand, the elderly (75 years and above) show a significant decrease in their standardised mortality ratio ($p<0.0001$).

When comparing inpatients with outpatients, there is always a higher standardised mortality ratio in inpatients (Table 1).

Older men who have had cataract surgery have a slightly higher standardised mortality ratio than women, but the difference is not statistically significant ($p=0.25$).

Diabetes known at the time of surgery increases the standardised mortality ratio (Table 2). There is in all groups roughly a doubling of the standardised mortality ratio in comparison with non-diabetics. In older outpatients, there is an approximately normal standardised mortality ratio, but this is worse than in older non-diabetic outpatients, who have a decreased standardised mortality ratio.

As in non-diabetics, older men who have had cataract surgery have a slightly higher standardised mortality ratio than women, but the difference is not statistically significant ($p=0.40$).

Among the diabetic patients operated on as inpatients, 75% subsequently died (calculation: $(20+91)/(29+119) \times 100 = 75$). The same percentage (71%) was found for all non-diabetic patients (calculation: $(58+551)/(105+749) \times 100 = 71$). The difference is not statistically significant (Fisher's exact test). We therefore see no reason to assume that the general health of the diabetic inpatients was much worse than in the non-diabetics at the time of surgery.

Table 3 shows that the standardised

Table 4 Standardised mortality ratio (SMR) in patients with non-diabetic cataract and with diagnoses of death related to the cardiovascular system

Age (years)	Inpatients		Outpatients		All	
	45-74	75+	45-74	75+	45-74	75+
Deaths in women:						
Observed	11	224	6	58	17	282
Expected	5.94	223.01	6.96	98.95	12.90	321.96
SMR	1.85	1.00	0.86	0.59	1.32	0.88
p Value	0.038	>0.5	>0.5	<0.0001	0.25	0.26
Deaths in men:						
Observed	18	112	13	57	31	169
Expected	9.77	109.68	13.53	61.28	23.30	170.96
SMR	1.84	1.02	0.96	0.93	1.33	0.99
p Value	<0.01	>0.5	>0.5	>0.5	0.11	>0.5
Deaths in both sexes:						
Observed	29	336	19	115	48	451
Expected	15.71	332.69	20.49	160.23	36.20	492.92
SMR	1.85	1.01	0.93	0.72	1.33	0.91
p Value	<0.001	>0.5	>0.5	<0.001	0.050	0.060

The p values indicate significance of difference when compared with the normal population.

mortality ratio for cancer deaths in patients operated for cataract does not deviate significantly from that of other inhabitants in Malmöhus County.

Only a few patients with diabetic cataract had diagnoses of cancer death (data not shown). There were no statistically significant deviations in the standardised mortality ratios when compared with the other patients with diabetic cataract.

Cardiovascular disease is one of the most common causes of death. Table 4 shows that there is a slight increase in the standardised mortality ratio in young inpatients operated for cataract. In outpatients, older women have a lowered standardised mortality ratio. The patients in the other groups do not have any statistically significant change in the standardised mortality ratio (Table 4).

Among the non-diabetic patients who later died because of cardiovascular diseases, there was no significant difference in the percentage operated on as inpatients $((29+336)/(48+451) \times 100 = 73)$ when compared with all non-diabetic patients $((58+551)/(105+749) \times 100 = 71)$.

Patients with diabetes at the time of surgery and who later died from a cardiovascular disease (Table 5) also showed increased standardised mortality ratios in most groups, but the increase was similar to that seen in diabetic patients (Table 2).

Table 5 Standardised mortality ratio (SMR) in patients with diabetic cataract and with diagnoses of death related to cardiovascular disease

Age (years)	Inpatients		Outpatients		All	
	45-74	75+	45-74	75+	45-74	75+
Deaths in women:						
Observed	6	27	1	8	7	34
Expected	0.77	18.63	0.43	6.78	1.20	25.41
SMR	7.79	1.45	2.33	1.18	5.83	1.34
p Value	-	0.052	-	>0.5	<0.0001	0.088
Deaths in men:						
Observed	5	21	4	9	9	30
Expected	1.07	8.84	1.99	7.65	3.06	16.49
SMR	4.67	2.38	2.01	1.18	2.94	1.82
p Value	<0.001	<0.0001	0.15	>0.5	<0.001	<0.001
Deaths in both sexes:						
Observed	11	48	5	17	16	64
Expected	1.84	27.47	2.42	14.43	4.26	41.90
SMR	5.98	1.75	2.07	1.18	3.76	1.53
p Value	<0.0001	<0.0001	0.10	0.50	<0.0001	<0.001

The p values indicate significance of difference when compared with the normal population.

Table 6 Variables and coefficients in the Cox's proportional hazard regression model. Exp(B) approximates the relative risk for one unit change of the covariate

Variables with statistical significance	Coefficients (B)	p Value	Exp(B)
Age (years)	0.0856	<0.0001	1.0893
Sex (women=0, men=1)	0.4594	<0.0001	1.5674
Intraocular pressure (mm Hg)	-0.0169	0.0354	0.9832
Diabetes (yes=1, no=0)	0.7036	<0.0001	2.0211
Rheumatoid arthritis (yes=1, no=0)	1.0123	<0.0001	2.7521
YAG capsulotomy (yes=1, no=0, time dependent)	-0.3847	0.0004	0.6807

INFLUENCE OF DIFFERENT VARIABLES ON MORTALITY

We considered the possible risk factors: sex, age, preoperative axial length, preoperative average keratometry, preoperative intraocular pressure, glaucoma history, diabetes history, uveitis history (including both anterior and posterior uveitis), age-related macular degeneration history, and rheumatoid arthritis history. Some of these possible risk factors are obvious, others were examined because other parts of this study suggested that they might be of some interest (Ninn-Pedersen, unpublished). We also considered the complications at surgery and YAG capsulotomy post-operatively. Besides age, five variables reached significance. They were sex, diabetes, pre-operative rheumatoid arthritis, preoperative intraocular pressure, and whether or not the patient had a YAG-capsulotomy postoperatively. The regression coefficients are given in Table 6. Increased mortality risks were found for men (1.57), diabetic patients (2.02), and rheumatoid patients (2.75).

Thompson *et al*⁵ noted a higher adjusted relative hazard for death in patients with nuclear cataract than in patients with other types. We did not score the type of the cataract, and our data therefore do not permit any such analysis.

Discussion

The operations analysed represent all cataract surgery patients in a well defined district, with only minor and insignificant data losses.¹⁰ There is not likely to be any economic selection bias in the figures, thanks to the compulsory and comprehensive social security system in Sweden. The total cost paid by the patient is very small and equivalent to about £20 to £30, everything included. Further, the mobility in the district was very low,¹⁰ and errors caused by an influx or outflux of patients in the district can therefore be ignored. Finally, all patients except six were found in the National Population Register, where their death dates and death diagnoses are recorded. There is thus no significant error in the mortality scoring. Consequently we find it likely that the figures presented here come close to representing the true standardised mortality ratios in the different patient groups.

It may be noted that cataract surgery is here used as a proxy for the disease, cataract. This

has some statistical effects, particularly among the elderly, as will be discussed.

The number of cataract operations in the district was 1.7 per 1000 inhabitants in 1986 and 3.6 per 1000 inhabitants in 1990.¹⁰ Comparable figures from other Western countries are usually lower.^{13 14} The average patient age did not increase during the period,¹⁰ but the accessibility of the surgical services is hard to assess and to compare with other studies in other ways. However, the accessibility is not likely to be low.

As a rule, inpatients showed a much worse standardised mortality ratio than outpatients. This is as expected, because good general health is an important selection criterion for outpatient surgery. Inpatients are therefore likely to be more fragile than outpatients. Most likely the selection bias was most prominent at the beginning of the study, when outpatient surgery was a new treatment mode.

It should be noted that the present study is based on all the cataract surgery patients in a well defined and monitored population during 1986 to 1990 (N=5120, inpatients as well as outpatients, one eye per patient). Even though the results are similar in many respects, the Framingham investigation,⁷ the Beaver Dam eye study,⁹ and the study of Street and Javitt⁸ were not designed in the same way. The latter was nationwide in the USA and very large, but it was restricted to Medicare beneficiaries, and to inpatients only. The amount of information on each patient was restricted, and surgery on both the first and the second eye was probably included. The Framingham study⁷ and the Beaver Dam eye study⁹ were also different, selecting 2000 and 4926 inhabitants, respectively, from the general population for examination.

There are reports suggesting that cardiovascular diseases correlate with increased mortality among cataract patients.^{5 16} In this study, it was true only for young patients undergoing inpatient cataract surgery. There is a strong bias towards patients of poor general health in this group, and the increased mortality rate is therefore hardly surprising. In fact, there is consistently a higher mortality rate among inpatients than outpatients, and selection bias is the most likely explanation for this.

The death risk factors that, by life table regression analysis, were found to be statistically significant were age, sex, diabetes, preoperative rheumatoid arthritis, preoperative intraocular pressure, and whether or not the patient had a YAG capsulotomy postoperatively. Intraocular pressure was marginally significant. Of these, age and sex can be regarded as trivial, reflecting well known demographic facts. Diabetes will be discussed separately. Rheumatoid arthritis has not been associated previously with any increased standardised mortality ratio in cataract patients, but it is known that, in general, such patients have an increased mortality risk, comparable with the figure found here.¹⁵ The reason for the inverse correlation with YAG laser capsulotomy and mortality risk is

probably that it is mainly the healthy patients with capsular haze who request YAG laser capsulotomy.

Diabetics showed a much increased standardised mortality ratio in this study, almost fivefold in the young inpatient group and less but still increased in the others. Further, the life table regression analysis showed that diabetes is one of the factors that influence the death risk in cataract patients. This is at variance with other studies,^{1 3} where diabetes was not a factor that significantly altered the relative mortality. However, in these studies the total number of cataract patients was not very high (167 and 193 respectively) and consequently the number of diabetics was small (not reported by Hirsch and Schwartz¹; 40 by Benson *et al*³; 571 in the present study). Furthermore, the cataract patients were not compared with the normal population, but with patients undergoing other kinds of surgery. Both these factors may have obscured the influence of diabetes. Selection bias may also have been present, because the studies were limited to patients choosing to have surgery at the hospital at which the investigations were made. On the other hand, the large, population based Framingham study⁷ found an association between lens changes and survival in diabetics but not in non-diabetics. Among diabetics, lens changes were associated with more than a doubling of the death rate. We concur with Ederer *et al*¹⁷ that diabetes is correlated with an increased death risk in cataract patients.

In this study, we have not seen any increased standardised mortality in cataract patients aged above or equal to 75 years, and only in patients below 75 is there an increased standardised mortality ratio. This is in good agreement with the recent Beaver Dam eye study⁹, where increased mortality was found to be associated with age, sex, and a number of systemic factors rather than cataract surgery itself. Our results also agree with the Framingham study,⁷ with mortality ratio results in Medicare beneficiaries,⁸ and with the smaller study of Cvetkovic *et al*,⁶ where the mortality of cataract patients was compared with spouses and other relatives. In fact, there is, in our data, a decreased standardised mortality ratio in patients who have undergone cataract surgery. While this may be encouraging, we suggest that the observation is more likely to be due to selection bias than to an effect of the surgery. Simply, chronologically old but biologically young patients are more likely to request cataract surgery than patients who are old in both respects.

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