Cataract surgery of eyes with previous vitrectomy – risks and benefits as reflected in the European Registry of Quality Outcomes for Cataract and Refractive Surgery

Running head: Cataract surgery of eyes with previous vitrectomy

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Introduction

Cataract extraction is one of the most frequent surgical procedures in many countries. It can be performed on eyes with or without previous ophthalmic surgical interventions, but previous interventions may affect the outcome. One example is vitrectomy, which is well known to accelerate the progression of nuclear sclerosis cataract. [1, 2] Moreover, cataract surgery in an eye that has had a prior vitrectomy can be challenging, and so surgery for post-vitrectomy cataract may have a higher risk of complications. This study explored the frequency and outcomes of cataract surgery on eyes with previous vitrectomy.

Methods

The European Registry of Quality Outcomes for Cataract and Refractive Surgery (EUREQUO) covers both cataract surgery and refractive surgery on the same web-based platform.[3] The present study used only the cataract surgery data. All data reported to the EUREQUO are anonymized. This study was performed according to the tenets of the Declaration of Helsinki.

The register contains data on baseline characteristics, surgery, and follow-up. According to its web form guidelines, mandatory baseline data to be reported include year of birth, sex, eye, best corrected distance visual acuity, target refraction, co-existing eye diseases, surgical difficulties, and previous ophthalmic surgeries. Options under co-existing eye diseases include glaucoma, macular degeneration, diabetic retinopathy, amblyopia, and other. This means that the common reasons for vitrectomy are not named parameters in the registry, but are all grouped under "other". Options under previous ophthalmic surgeries are previous corneal refractive surgery, previous vitrectomy, and other. Mandatory surgical data to be reported include date of surgery, type of operation, intraocular lens material, and complications during surgery.

Complete reporting also includes mandatory follow-up data, such as date of examination, uncorrected distance visual acuity, best corrected distance visual acuity, refraction, macular degeneration (known before or revealed after cataract extraction), and postoperative complications. Clinics decide before joining the database whether they will report complete data or only preoperative and surgical data. The agreement between a clinic or surgeon and the EUREQUO gives access to the report function with a login page. In accordance with the protocol, consecutive cases were reported to the database by participating units, and a follow-up examination was performed 7–60 days after surgery.

Statistical methods

All analyses were performed using version 25 of IBM SPSS (SPSS Inc., Chicago, IL, USA) at a 5% significance level. Univariate analyses used a t-test for continuous data and a chi-squared test for categorical data. Multivariate analyses were performed as stepwise logistic regression analysis.

Results

As of 31 December 2018, the EUREQUO database contained 19,416 cases with a cataract extraction on an eye with previous vitrectomy, comprising 1.1% of the 1,715,348 reported procedures with registered postoperative data during the study period (1 January 2008 to 31 December 2018). The mean age of the patients was 64.1 ± 10.1 years, which was significantly younger compared with the rest of the database (73.7 ± 9.8 years; $p<0.001$). Female representation in previous vitrectomy cases was 47.5% compared with 58.1% for the rest of the database ($p<0.001$). The preoperative corrected distance visual acuity (CDVA) for eyes with previous vitrectomy was LogMAR 0.61 ± 0.35 (decimal 0.25) compared with 0.37 ± 0.27 (decimal 0.45) for the non-vitrectomized eyes ($p<0.001$).

The occurrence of previous vitrectomy in the annual EUREQUO cohorts is shown in Table 1.

Table 1. Number of eyes with previous vitrectomy and total number of operated eyes.

Year	Total number of surgeries	Number of cases with previous vitrectomy	Percentage of total
2008	93,344	930	1.00
2009	120,186	1189	0.99
2010	142,594	1539	1.08
2011	155,717	1744	1.12
2012	166,189	1775	1.07
2013	173,118	2133	1.23
2014	189,682	2378	1.25
2015	149,143	1785	1.20
2016	163,482	1951	1.19
2017	182,560	2009	1.10
2018	179,333	1983	1.11

The reasons for previous vitrectomy are not included in the EUREQUO list of parameters. Sight-threatening comorbidities other than retinal pathology leading to vitrectomy were significantly less frequent in the vitrectomized cohort than in the rest of the database, with age-related macular degeneration in 4.7% versus 9.2% of cases and glaucoma in 2.7% versus 6.3% of cases, respectively.

Table 2 shows the relationship between previous vitrectomy and reported surgical difficulties and complications.

Table 2. Reported surgical difficulties and complications for cases with previous vitrectomy and the rest of the database.

	Previous vitrectomy	**Rest of database**
Total number of cases	19,416	1,695,932
Surgical difficulty		
Small pupil	1.9%	2.6%
White cataract	2.3%	2.0%
Corneal opacities	0.7%	1.8%
Pseudoexfoliation	0.2%	0.7%
Previous corneal refractive surgery	1.1%	0.2%
Other difficulty	12.5%	6.8%
Surgical complication		
Iris damage	0.24%	0.29%
Posterior capsule complication	1.19%	1.06%
Dropped nucleus	0.40%	0.07%
Other surgical complication	2.10%	0.97%

Visual outcome

A follow-up visit was reported for 16,025 (82.5%) patients but not for the remaining 3,391. The average time to follow-up was 30.6 ±8.7 days.

Table 3 shows the percentage of preoperative and postoperative CDVA of patients with previous vitrectomy distributed in baseline groups. The groups represent:

(1) very good vision: LogMAR 0.0 or better (≥1.0);

(2) good vision: LogMAR 0.1 (0.8–0.9);

(3) impaired vision, but good enough for driving and reading: LogMAR 0.2-0.3 (0.5–0.7);

(4) poor vision, good enough for reading but not for driving a car:

LogMAR 0.4-0.5 (0.3–0.4); and

(5) low vision, not good enough for comfortable reading:

LogMAR 0.6 or worse (≤0.25).

n=15,805 (3,611 cases with missing postoperative visual acuity data).

Table 3. The Lundström matrix: [4]visual outcome related to preoperative visual acuity group

Preoperative VA group	Number of cases	Postoperative VA group (%)				
		1	2	3	4	5
1	231	83.1	6.5	5.6	0.4	4.3
2	510	84.1	9.8	5.1	0.8	0.2
3	3497	67.1	19.0	11.6	1.7	0.6
4	3918	47.2	22.5	23.8	5.1	1.5
5	6437	29.1	16.7	27.3	13.5	13.5
All	15805	43.4	17.8	21.6	8.3	8.9

Green: improvement to a better visual acuity group.
Red: deterioration to a worse visual acuity group.
Grey: status quo.

The visual outcome related to co-existing comorbidity is outlined in Table 4.

Table 4. Visual outcome related to co-existing eye diseases

Postoperative VA group	No co-morbidity (%) n=4,767	Ocular co-morbidity (%) n=11,038
1	59.9	36.3
2	16.4	18.4
3	15.5	24.2
4	4.4	10.0
5	3.8	11.2

To summarize Tables 3 and 4, a postoperative visual acuity of LogMAR 0.3 or better (Snellen 20/40, decimal ≥0.5) was achieved by 82.8% of cases (13,077/15,805) with previous vitrectomy compared with 95.6% (1,361,708/1,425,904) for the rest of the database. For cases with no ocular co-morbidity and previous vitrectomy, 91.8% (4,373/4,767) achieved this visual outcome, while the corresponding figure for patients with co-existing ocular comorbidity and previous vitrectomy was 78.9% (8,704/11,038).

Refractive outcome

The absolute mean biometry prediction error for cases (n=16,010; 3,406 missing) with previous vitrectomy was 0.52 ±0.75 dioptres (D) compared to 0.43 ±0.51 D for cases without previous vitrectomy (p<0.001). A biometry prediction error within 0.5D was achieved by 68.3% in the previous vitrectomy group compared to 72.0% in the non-vitrectomized group (p<0.001), and the corresponding figures for an error within 1.0D were 89.6% and 92.9%, respectively (p<0.001). The relationship between refractive outcome, previous vitrectomy, and risk factors for surgical complications (i.e. ocular comorbidity and surgical difficulty) is shown in Table 5.

Table 5. Relationship between refractive outcome, previous vitrectomy, and risk factors for surgical complications (i.e. ocular comorbidity and surgical difficulty). Stepwise logistic regression.

Independent variable (n)	**Dependent variable: biometry prediction error ±0.5D n = 1,000,075**				
	B	P	Exp(B)/OR	95% CI lower	95% CI upper
Previous vitrectomy (16,010)	0.125	<0.001	1.134	1.094	1.174
Surgical difficulty other than previous vitrectomy (102,237)	0.272	<0.001	1.313	1.298	1.328
Ocular comorbidity (227,972)	0.234	<0.001	1.263	1.252	1.274
Age (999,650)	-0.004	<0.001	0.996	0.996	0.996
Gender (999,972)	-0.015	<0.001	0.985	0.978	0.992
Independent variable (n)	**Dependent variable: biometry prediction error ±1.0D n = 1,289,653**				

Previous vitrectomy (14,348)	0.255	<0.001	1.290	1.222	1.361
Surgical difficulty other than previous vitrectomy (144,148)	0.508	<0.001	1.662	1.633	1.690
Ocular comorbidity (303,346)	0.447	<0.001	1.563	1.541	1.585
Age (1,289,514)	0.003	<0.001	1.003	1.003	1.004
Gender (1,289,514)	-0.047	<0.001	0.954	0.942	0.967

Exp(B) = exponentiation of B
CI = confidence interval
OR = odds ratio

Postoperative complications

The reported postoperative complications during the first month for eyes with previous vitrectomy included corneal oedema (0.12%), uncontrolled intraocular pressure (0.16%), and endophthalmitis (0.04%), among others. Any postoperative complication was reported in 4.64% of the 16,030 cases with previous vitrectomy and 1.96% of the 1,376,137 cases without. The relationship between any postoperative complication and previous vitrectomy and risk factors (i.e. ocular comorbidity and surgical difficulty) is outlined in Table 6.

Table 6. Relationship between any postoperative complication as dependent variable (n = 27,699) and previous vitrectomy, ocular comorbidity, surgical difficulties, age, and gender (independent variables). All risk factors (ocular comorbidity and surgical difficulty) refer to the surgery eye. Stepwise logistic regression.

Variable (n)	B	p	Exp(B)/ OR	95% CI lower	95% CI upper
Ocular comorbidity (12,852)	0.957	<0.001	2.604	2.540	2.670
Surgical difficulty other than previous vitrectomy (5,866)	0.515	<0.001	1.674	1.624	1.725
Gender (27,696)	0.115	<0.001	1.122	1.095	1.149

Previous vitrectomy (744)	0.112	0.006	1.119	1.033	1.211
Age (27,680)	0.014	<0.001	1.014	1.012	1.015

Exp(B) = exponentiation of B
CI = confidence interval
OR = odds ratio

Discussion

In this study we explored the incidence and outcomes of cataract surgery in previously vitrectomized eyes. Our use of a large database with consecutive cases can add knowledge of this subject, particularly given the absence of randomized controlled trials on which to base clinical recommendations for cataract surgery after vitrectomy.[2]

The mean age of patients undergoing cataract extraction after previous vitrectomy in our study was 64.1 years compared to 73.7 years for the rest of the database patients. Similarly, Gupta et al.[5] reported a mean age of 61.5 years in their study of myopic eyes undergoing cataract extraction post vitrectomy. This relatively young age at cataract surgery is related to the age when a vitrectomy is performed. A large study in the United States (>40,000 vitrectomies) found that the average age when patients underwent vitrectomy was 57±13 years.[6] According to several authors, in many cases a nuclear sclerosis develops within 2 years of a vitrectomy.[1, 2] The average preoperative visual acuity among the vitrectomy cases in our study was LogMAR 0.61 (0.25 Snellen), which was significantly worse compared with the eyes that did not undergo vitrectomy. A poor preoperative visual acuity (LogMAR 0.8, 20/125) was also reported by Grusha et al.[7] The poor preoperative visual acuity in post-vitrectomy eyes before cataract surgery could be explained by a combined effect of the disease that caused the vitrectomy and the advancing nuclear sclerosis. The incidence of previous vitrectomy annually in our registry was reasonably stable over the eleven years (0.99% – 1.25%). This is surprising, as one can assume that combined procedures (vitrectomy + cataract extraction) have increased in frequency over the years. Reports on the occurrence of previous vitrectomy in a cataract surgery dataset are scarce in the literature.

The occurrence of reported co-existing eye diseases in post-vitrectomy cataract eyes in our study was lower than in the rest of the database, except for diseases that required vitrectomy. This is not surprising given the difference in mean age between the groups. Regarding surgical difficulties during cataract extraction, most of the options represented in the EUREQUO database were under-represented except for previous corneal refractive surgery

and “other” difficulties.

In contrast to the finding by Diaz Lacalle et al.[8] that a substantial proportion of their vitrectomized eyes showed a small pupil, in our study small pupil as a surgical problem was more frequent among the non-vitrectomized eyes in the database. However, this may be related to both surgical difficulties being included as options in the same parameter, representing a registration challenge. Other surgical difficulties following vitrectomy described in the literature include sudden change in anterior chamber depth and unusual mobility of the posterior capsule.[8]

In our study, dropped nucleus and “other” surgical complications were significantly more frequent in the post-vitrectomy eyes than in the rest of the database. The frequency of complications was relatively low compared to some previous studies. Hocaoglu et al.[9] found a posterior capsule rupture in 5.5% of cases and nucleus material in the vitreous in 3.3% of cases, compared to 1.19% and 0.4% respectively in our study. A study of dropped nucleus[10] found previous vitrectomy to be a predisposing factor, and another study reported that the incidence of posterior capsule tear was 2.3%.[7] Other surgical complications or difficulties described in the literature include hardening of the nucleus compared to age-related nuclear sclerosis[2] and patients being more aware of pressure changes during surgery because of the instability of the capsule and zonula.[11]

In our study, patients with previous vitrectomy had slightly worse visual outcome than the rest of the database patients. Looking at the functional groups,[4] between 84.1% and 93.5% improved their function to a better group, meaning more ability to cope with daily life activities (Table 5). The best visual outcome in our study of previous vitrectomy had patients with no co-existing eye disease (Table 4). Unfortunately, the literature contains several ways of describing visual outcome, such as increased number of Snellen lines, percentage over a certain limit, and mean LogMAR. However, our results can be compared with the median visual outcome of 20/30 (LogMAR 0.18) and 72.7% better than 20/40 (LogMAR 0.30) reported by Grusha et al.[7] In our study, the median visual outcome was LogMAR 0.1 (decimal 0.8) (data not shown) and 82.8% achieved LogMAR 0.30 (decimal 0.5) or better.

The refractive outcome after cataract surgery was worse in eyes with previous vitrectomy than in those with no previous vitrectomy; this difference was statistically significant although not large. A previous study[12] found that refractive outcome following phacoemulsification sequential to pure vitrectomy was comparable to that in control patients with no history of vitrectomy.

Secondary glaucoma was reported by Biro & Kovacs[13] as a postoperative complication. In our study, uncontrolled elevated intraocular pressure was rare but was significantly more common after post vitrectomy cataract extraction compared with no previous vitrectomy.

One weakness in our study is the fact that data in the registry are self-reported by surgeons or clinics. Another is that a registry must limit the number of parameters to be reported, in order to reduce the clinical burden for the participating clinics. In this study, we analysed a parameter that was reported for about 1% of all surgeries, and conditions related to this parameter constituted fractions of 1%, meaning that some co-existing eye diseases and other risk factors were included in "other" options. A third weakness that must be considered is our lack of data on the indication for the previous vitrectomy and the visual acuity after the vitrectomy. Conversely, the large amount of reported cases from many countries and data spanning more than a decade are strengths of the study which in our opinion mean that our findings are robust.

In conclusion, we found that patients undergoing cataract extraction after previous vitrectomy were younger, were majority men, had fewer ocular comorbidities, and had similar surgical difficulties as non-vitrectomized patients. The visual and refractive outcomes for post-vitrectomy cataract surgery patients were slightly inferior to those of their non-vitrectomized counterparts but were still good.

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What was known before

- Patients undergoing cataract extraction after previous vitrectomy are on average younger than their non-vitrectomized counterparts and are more likely to experience surgical complications.

What this paper adds

- Patients going through a cataract extraction after previous vitrectomy are majority men and have fewer ocular comorbidities and similar surgical difficulties as non-vitrectomized patients.
- Visual and refractive outcomes for post-vitrectomy cataract surgery patients are slightly inferior to those among patients with no history of vitrectomy but are still good.