

Visual Outcomes after Cataract Surgery in Diabetic Patients: A Meta-Analysis

Dear Editor,

Diabetic retinopathy is a common complication of diabetes which can result in blindness. Studies have generally shown that visual outcomes after cataract surgery in patients with diabetes are worse than in non-diabetics, especially those with diabetic retinopathy.¹⁻³ In patients with diabetic retinopathy, a major cause of unfavourable outcomes after cataract surgery is macular oedema.⁴ Factors associated with significant macular oedema include the duration of diabetes, glycaemic control, degree of retinopathy, and macular oedema at the time of surgery.^{4,5} Increased retinopathy progression and increased incidence of macular oedema after cataract surgery have been reported in patients with diabetes,¹ while other studies have not reported these findings.⁶ Some authors suggested that the findings are due to the natural course of diabetes.^{5,7}

To this end, we performed a meta-analysis to determine outcomes of cataract surgery in diabetic patients with diabetic retinopathy as compared to those without retinopathy.

Materials and Methods

Medline, Cochrane, and Google Scholar databases were searched from inception until January 30, 2015 using combinations of the following keywords: visual outcome, cataract surgery, diabetes, diabetic retinopathy. Inclusion criteria for the meta-analysis were: 1) two-arm studies; 2) one group of eyes that had diabetic retinopathy and another that did not; 3) that both groups of eyes had undergone cataract surgery; 4) quantitative outcomes that had been reported. Single-arm studies and those with patients receiving medical treatment (enoxaparin, ranibizumab, or triamcinolone, etc.) in addition to cataract surgery to prevent macular oedema were excluded. Letters, comments, editorials, case reports, proceedings, and personal communications were also excluded. Studies were identified by the search strategy via two independent reviewers.

Information/data extracted from studies that met the inclusion criteria were: the name of the first author, year of publication, study design, number of participants in each group, participants' age and gender, presence of retinopathy and the major outcomes. The method described by Hayden et al⁸ was used to assess the quality of the included studies.

Outcome measures were: 1) percentage of eyes with

postoperative newly developed macular oedema; 2) percentage of eyes with progressive retinopathy; 3) percentage of eyes with visual acuity reaching 6/12. Odds ratios (ORs) and 95% confidence intervals (95% CIs) were used to represent the effect size of associations between diabetic retinopathy and outcomes. An OR >1 indicated that patients with diabetic retinopathy had greater odds of developing macular oedema and progressive retinopathy compared to those without diabetic retinopathy, and that patients with diabetic retinopathy had greater odds of visual acuity improvement than those without diabetic retinopathy. Heterogeneity among the studies was assessed by the Cochran Q and the I² statistic. A Q statistic $P < 0.10$ was considered to indicate statistically significant heterogeneity. An I² statistic $\geq 50\%$ was considered to indicate large to extreme heterogeneity. Random-effects models were used if heterogeneity was detected (I² >50% or Q statistics $P < 0.10$). Otherwise, fixed-effects models were used. A two-sided $P < 0.05$ was considered statistically significant. Meta-analysis sensitivity was assessed with the leave-one-out approach. Statistical analyses were performed using Comprehensive Meta-Analysis statistical software, version 2.0 (Biostat, Englewood, NJ, USA).

Results

A total of 370 articles were identified, and 330 remained after duplicates were removed. After screening by abstracts and titles, 283 were excluded and the full-texts of 47 articles were reviewed. Thirty-nine articles were excluded for not meeting the inclusion criteria. Ultimately, 8 studies were included in the meta-analysis.^{1,2,4,9-13} The number of patients in the 8 studies ranged from 30 to 119, and number of eyes ranged from 30 to 180. The mean or median age ranged from 66.4 to 76 years, and the proportion of males ranged from 32% to 79% (Table 1).

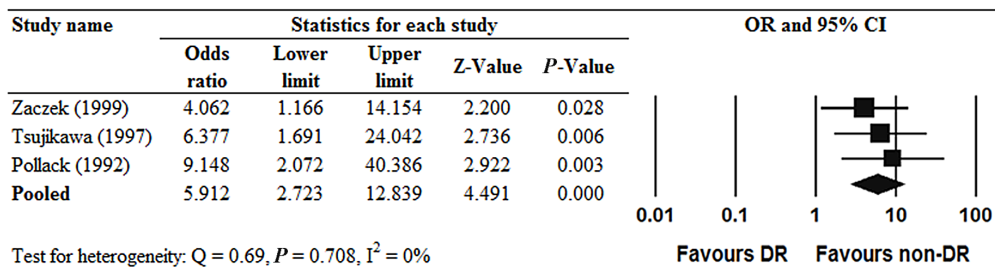
There was no evidence of heterogeneity across 3 studies that reported outcomes of newly developed macular oedema. Patients with diabetic retinopathy had higher odds of developing macular oedema than those without diabetic retinopathy (pooled OR = 5.912, 95% CI: 2.723 to 12.839, $P < 0.001$) (Fig. 1a).

There was no evidence of heterogeneity across 5 studies that reported outcomes of progressive retinopathy. Patients

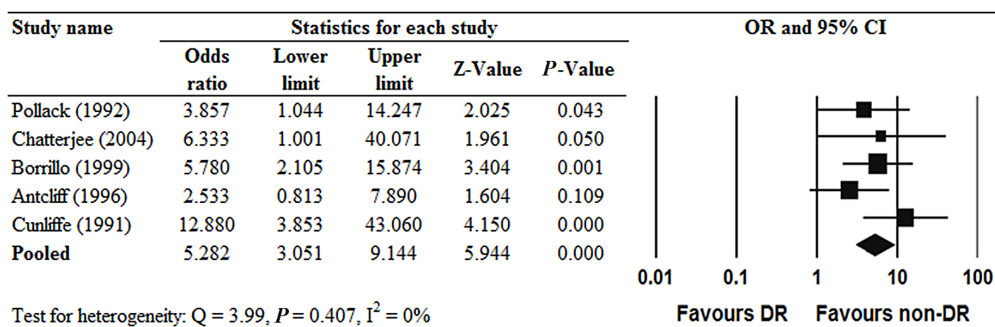
Table 1. Characteristics of Studies Included in the Meta-Analysis

First Author (Publication Year)	Study Design	No. of Patients	Length of Follow-up	Group	No. of Eyes in Each Group	Cataract Surgery	Age (Years)	Male	Retinopathy Subgroup	No. of Patients in Retinopathy Subgroup
Cunliffe (1991)	Retrospective	60	2.6 years	Non-diabetics	66	Extracapsular cataract extraction	70.5	42%	Non-diabetics	66
				Diabetics	66		73.9	42%	Without retinopathy Background Proliferative	33 23 10
				Non-diabetics	25		71.2	40%	Non-diabetics	25
Pollack (1992)	Retrospective	79		Diabetics	44		66.7	32%	Without retinopathy With retinopathy	28 16
Antcliff (1996)	Retrospective	63	12 months	Without retinopathy	24	Phacoemulsification and intraocular lens implantation	67	41%	Without retinopathy	24
				With retinopathy	50				Background Proliferative	23 27
				Diabetics	140	Extracapsular cataract extraction	68.6	43%	Without retinopathy Background Preproliferative Quiescent proliferative Active proliferative	83 42 3 9 3
Tsujikawa (1997)	Retrospective	102	6 months	Diabetics	140					
Borrillo (1999)	Retrospective	119	10 months	Without retinopathy	56	Phacoemulsification	62.2	34%	Without retinopathy	56
				With retinopathy	94				Non-proliferative Proliferative	49 45
				Non-diabetics	22	Uncomplicated, phacoemulsification	Median: 76	55%	Non-diabetics	22
Zaczek (1999)	Prospective		12 months	Diabetics	52		Median: 73	39%	No/mild-moderate Proliferative	27 25
Sadiq (1999)	Retrospective			Non-diabetics	28	Phacoemulsification	69.3	32%	Non-diabetics	
				Diabetics	28		66.4	50%	Without retinopathy Background Maculopathy Proliferative Non-diabetics	14 8 5 1
				Non-diabetics	90	Extracapsular cataract extraction	72.3	46%	Without retinopathy	78
Chatterjee (2004)	Retrospective	30	12.4 months	Diabetics	90		74.4	42%	Without retinopathy Background Proliferative Maculopathy	8 1 3
				Without retinopathy	22	Phacoemulsification			Without retinopathy	22
				With retinopathy	8		68.9	50%	Non-proliferative Proliferative	5 3

(a) Newly developed macular oedema



(b) Progressed retinopathy



(c) Visual acuity reaching 6/12

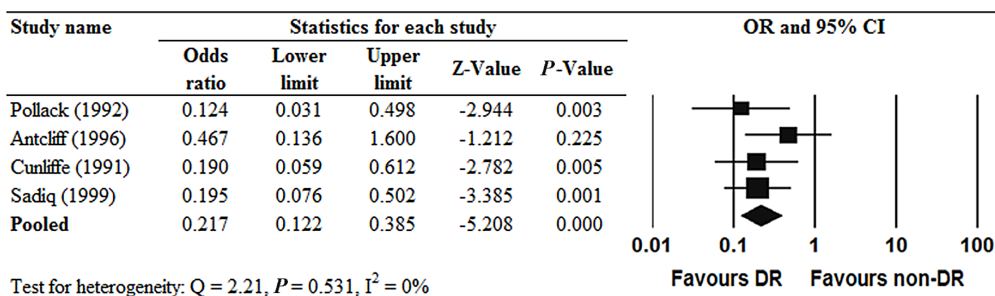


Fig. 1. Forest plots for association of diabetic retinopathy on (a) newly developed macular oedema, (b) progressive retinopathy and (c) visual acuity reaching 6/12.

with diabetic retinopathy had higher odds of developing progressive retinopathy than those without diabetic retinopathy (pooled OR = 5.282, 95% CI: 3.051 to 9.144, $P < 0.001$) (Fig. 1b).

There was no evidence of heterogeneity across 4 studies that reported visual acuity outcomes. Patients with diabetic retinopathy had lower odds of visual acuity reaching 6/12 than those without retinopathy (pooled OR = 0.217, 95% CI: 0.122 to 0.385, $P < 0.001$) (Fig. 1c).

Sensitivity analyses showed that the magnitude and direction of the outcomes did not change considerably, indicating that there was no single study that had a significant

impact on the pooled results of any of the outcomes (Fig. 2). Quality assessment demonstrated a low risk of bias in both study participation and study attrition. A moderate risk was estimated in prognostic factor measurement, outcome measurement and analysis. All the studies showed a high risk of bias in confounding measurement and account.

Discussion

This meta-analysis showed that patients with diabetic retinopathy had higher odds of developing macular oedema, progressive retinopathy, and lower odds of achieving visual acuity of 6/12 after cataract surgery. Only one prior meta-analysis performed in 1995 examined outcomes of

(a) Newly developed macular oedema

Study name	Statistics with study removed					OR and 95% CI with study removed
	Odds ratio	Lower limit	Upper limit	Z-Value	P-Value	
Zaczek (1999)	7.485	2.783	20.135	3.987	0.000	
Tsujikawa (1997)	5.685	2.186	14.782	3.564	0.000	
Pollack (1992)	5.020	2.022	12.462	3.477	0.001	
Pooled	5.912	2.723	12.839	4.491	0.000	

(b) Progressed retinopathy

Study name	Statistics with study removed					OR and 95% CI with study removed
	Odds ratio	Lower limit	Upper limit	Z-Value	P-Value	
Pollack (1992)	5.689	2.870	11.277	4.980	0.000	
Chatterjee (2004)	5.191	2.675	10.072	4.869	0.000	
Borrillo (1999)	5.138	2.402	10.987	4.220	0.000	
Antcliff (1996)	6.606	3.530	12.363	5.904	0.000	
Cunliffe (1991)	4.187	2.261	7.754	4.555	0.000	
Pooled	5.282	3.051	9.144	5.944	0.000	

(c) Visual acuity reaching 6/12

Study name	Statistics with study removed					OR and 95% CI with study removed
	Odds ratio	Lower limit	Upper limit	Z-Value	P-Value	
Pollack (1992)	0.243	0.129	0.458	-4.383	0.000	
Antcliff (1996)	0.175	0.091	0.335	-5.250	0.000	
Cunliffe (1991)	0.226	0.114	0.450	-4.235	0.000	
Sadiq (1999)	0.230	0.109	0.487	-3.847	0.000	
Pooled	0.217	0.122	0.385	-5.208	0.000	

Fig. 2. Sensitivity analysis for association of diabetic retinopathy on (a) newly developed macular oedema, (b) progressive retinopathy and (c) visual acuity reaching 6/12.

cataract surgery in patients with diabetes, and the study found that the severity of retinopathy and maculopathy prior to cataract surgery were the major factors affecting postoperative visual acuity.³

Dowler et al¹⁴ reported that phacoemulsification was associated with better visual outcomes, less need for capsulotomy, and less inflammation as compared to extracapsular extraction in patients with diabetes. While visual outcomes in diabetic patients with or without minimal retinopathy are similar to those without diabetes, postoperative visual acuity may be less than optimal in patients with significant retinopathy.¹³ In eyes without macular oedema at the time of surgery, the occurrence of postoperative macular oedema tends to resolve

spontaneously. In cases where macular oedema persists, it may represent the natural course of diabetes rather than the effect of surgery.⁵ Clinically significant macular oedema at the time of cataract surgery, however, is unlikely to resolve postoperatively.⁵ Krepler et al⁷ reported poorer visual outcomes in patients developing macular oedema after phacoemulsification and posterior chamber lens implantation. Eriksson et al¹⁵ reported final visual outcomes in eyes with mild to moderate retinopathy without previous macular oedema were as good as that in normal eyes.

Diabetic retinopathy can progress after intracapsular and extracapsular cataract extraction.¹⁶ On the other hand, some studies have shown similar results with phacoemulsification, while others have reported no effect on retinopathy as a result

of phacoemulsification.⁷ Differences in outcomes may be attributable to different criteria used to define progressive retinopathy. Two prospective studies of phacoemulsification in patients with diabetes indicated the procedure does not accelerate diabetic retinopathy, and progression is likely the result of the natural course of the diabetes.⁵

The results of this study must be interpreted with caution due to a number of limitations. The number of studies was only 8 and the total number of patients was small. All 8 studies did not address all outcomes, and all the studies were performed in the 1990s with the exception of one performed in 2004. Data from older studies may not necessarily reflect current outcomes due to advances in surgical techniques. The surgical approach and patient grouping and selection varied between studies, and different surgical approaches are associated with different results. We did not distinguish between proliferative and non-proliferative diabetic retinopathy, or examine confounding factors. Lastly, we did not stratify retinopathy, account for glucose control, or consider prior treatments as the number of studies were so limited.

Conclusion

In conclusion, worse outcomes are seen in diabetic patients with retinopathy after cataract surgery than in those without retinopathy. The results, however, should be interpreted with caution due to a lack of recent studies.

Acknowledgements

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Rui Guo, ¹PhD, Xiaohong Yang, ¹MD, Xiaoyan Xie, ²MD

¹Guangdong Eye Institute, Department of Ophthalmology, Guangdong General Hospital, Guangdong Academy of Medical Sciences, People's Republic of China

²Department of Ophthalmology, Guangzhou Hospital of TCM, People's Republic of China

Address for Correspondence: Dr Yang Xiaohong, Guangdong Eye Institute, Department of Ophthalmology, Guangdong General Hospital, Guangdong Academy of Medical Sciences, 106 Zhongshan Er Road, Guangzhou, 510080, Guangdong, People's Republic of China.

Email: 13922331056@139.com