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The visual results and changes in retinopathy in diabetic patients following cataract surgery

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ABSTRACT: Introduction. *A study was designed to investigate the visual improvement and incidence of progression of retinopathy in diabetic patients following extracapsular cataract extraction or phacoemulsification. They were compared to a matched group of non-diabetic patients.*

Methods. *A retrospective analysis of all diabetic patients (118) undergoing ECCE (90) or phacoemulsification (28) in 1995. These patients were operation and age matched with 118 non-diabetic patients who underwent surgery during the same year.*

Results. *There was no statistically significant difference in complications following ECCE in diabetic and non-diabetic patients (p=0.2). Complications were however more common in non-diabetic patients undergoing phacoemulsification compared to diabetics undergoing the same procedure (p=0.046). Although consultants performed 42% of the surgery in diabetics compared to 31% in non-diabetics, there was no significant difference in the rate of complications between consultants and residents (p=0.8). Overall the visual improvement in non-diabetics was better than diabetic patients (p=0.006). This was due to a better improvement amongst non-diabetic patients undergoing phacoemulsification (p=0.02). Overall, cataract surgery was found to lead to a worsening in retinopathy in 19 operated eyes (15 had no retinopathy preoperatively) compared to a worsening in 8 fellow eyes. This was statistically significant (p=0.04). However, ECCE was no more likely to cause worsening of retinopathy than phacoemulsification (p=0.87).*

Conclusions. *Diabetic patients due to undergo cataract surgery a) have a good chance of visual improvement but to a level less than if they were not diabetic, b) have a greater chance of visual loss, c) surgery may initiate or worsen any pre-existing retinopathy and this may affect their vision in the future. (Eur J Ophthalmol 1999; 9: 14-20)*

KEY WORDS: Diabetes, Extracapsular extraction, Phacoemulsification, Vision, Retinopathy

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INTRODUCTION

Diabetics have an increased risk of developing cataract. As surgery may be required to improve patients' vision, as well as to facilitate retinal observation and/or treatment, a significant amount of cataract surgery is performed in diabetic patients. This is estimated to amount to about 10% of the average workload of an ophthalmology department in a district hospital (1).

For many years it has been known that intracapsular surgery (ICCE) had more complications (eg. vitreous haemorrhage, neovascular glaucoma) than extracapsular surgery (ECCE) in diabetics' eyes (2, 3). More recent studies have shown that cataract surgery in diabetic patients does have a good prognosis, but is still associated with progression of diabetic retinopathy following surgery (4-8). We investigated the visual improvement and incidence of progression of retinopathy following extracapsular extraction or phacoemulsification in our unit, and compared them to the visual results in non-diabetic patients. From these results, we hoped to be able to provide our di-

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TABLE I - PATIENT DEMOGRAPHICS

	Diabetics ECCE (GpA)	Phaco (GpB)	Controls ECCE (GpC)	Phaco (GpD)
Number	90	28	90	28
Male	38 (42.2%)	14 (50%)	41(45.6%)	9 (32.1%)
Female	52 (57.8%)	14 (50%)	49 (54.4%)	19 (67.9%)
Mean age (yrs)	74.4	66.4	72.3	69.3
(range)	(46-91)	(33-87)	(45-91)	(27-89)
Hypertension	19 (21.1%)	12 (42.9%)	14 (15.6%)	5 (17.9%)
Glaucoma	7 (7.8%)	1 (3.6%)	7 (7.8%)	3 (10.7%)

abetic patients with an odds risk ratio for visual improvement or deterioration when compared to non-diabetic patients.

PATIENTS AND METHODS

The files of all 118 diabetic patients undergoing cataract surgery with intraocular lens implantation between January 1995 and December 1995 were retrospectively analysed. Ninety patients (group A - 76%) underwent ECCE, and 28 (group B - 24%) underwent phacoemulsification. These patients were randomly matched for operation and age (to 5 year bands) with 118 patients from a total of 780 non-diabetics undergoing ECCE or phacoemulsification during the same period, forming groups C and D respectively. The average follow-up in both groups was 24 months (range 18 to 30 months). There were 3 deaths in the diabetic groups, but as these occurred after a follow up of more than 12 months, the results are included in the analysis. Similarly, there were two deaths in the non-diabetic groups. Statistical advice was obtained before the start of the study. Analysis was performed using the sign, X^2, Fisher or McNemar tests.

The following information was noted from the files where applicable: age at time of surgery, sex of patient, operated side, operation date, grade of surgeon, type of surgery, site of implant placement, state of posterior capsule, other peroperative and postoperative complications, the requirement for any medication to control hyperglycaemia, the preoperative visual acuity and diabetic retinopathy status in the operated and fellow eyes, the post-operative visual acuity and diabetic retinopathy status in the operated and fellow eyes, the intraocular pressures, the requirement for a YAG capsulotomy.

TABLE II - TREATMENTS FOR DIABETES

	ECCE (n=90) (Gp A)	Phaco (n=28) (Gp B)
Diet controlled	53 (58.9%)	11 (39.3%)
Oral hypoglycaemics	11 (12.2%)	9 (32.1%)
Insulin	26 (28.9%)	8 (28.6%)
Total	90`(100%)	28 (100%)

The retinal examination was conducted by the ophthalmologist who listed the patient for surgery, and this was confirmed by the consultant ophthalmic surgeon immediately preoperatively. The retinopathy status was based on direct ophthalmoscopy and fundus biomicroscopy. Fundus fluorescein angiography was only performed when indicated in order to distinguish between types of maculopathy. In those in whom the fundal view was precluded by dense cataract, the retinopathy status on the very first postoperative day was taken as the baseline retinopathy status. Retinopathy was graded using a modification of the Airlie-House classification (9).

RESULTS

The patient demographics are shown in Table I. Table II shows the hypoglycaemic treatments which were taken by the diabetic patients. In the diabetic group, surgery was performed by consultants in 50 patients, and by ophthalmic residents (under supervision) in 68 patients. In the non-diabetic group, surgery was performed by consultants in 36 patients, and by oph-

TABLE III - PRE- AND POST-OPERATIVE MEDIAN VISUAL ACUITY IN EACH GROUP

	Diabetics ECCE (n=90) (Gp A)	Phaco (n=28) (Gp B)	Controls ECCE (n=90) (Gp C)	Phaco (n=28) (Gp D)
Preop. (range)	6/36 (6/6-PL)	6/36 (6/12-CF)	6/60 (6/9-HM)	6/24 (6/18-HM)
Postop. (range)	6/9 (6/6-HM)	6/9 (6/6-CF)	6/9 (6/6-HM)	6/6 (6/6-6/9)

thalmic residents in 82 patients. Although consultants performed more cataract surgery in the diabetic group (42%) compared to the non-diabetic group (31%), this was not statistically significant (X^2=3.6, p=0.06). Preoperative and postoperative complications in group A (n=90) consisted of residual soft lens matter in 4 patients (4.4%), partial zonule dehisence in one, operative hyphaema in one, peripheral iridectomy in one, iris-wound adherence in one, posterior capsule rupture in 5 (5.6%), and an aggressive uveitis in three (3.3%). In group B (n=28), the only complication consisted of a peroperative iris prolapse requiring a peripheral iridectomy. In group C (n=90), complications consisted of residual soft lens matter in 3 patients (33%), peripheral iridectomy in two, posterior capsule rupture in 11 (12.2%), iris prolapse in two, and an aggressive uveitis in two (2.2%). Two more later required compression sutures and one sustained corneal decompensation. In group D (n=28), one had a peroperative hyphaema, three (10.7%) had posterior capsule rupture, one had a transiently raised intraocular pressure, and one had an aggressive uveitis. There was no statistically significant difference in complications following ECCE in diabetic and non-diabetic patients (X^2=1.6, p=0.2). Complications were however more common in non-diabetic patients undergoing phacoemulsification compared to diabetics undergoing the same procedure (Fisher's test p=0.046). There was no statistically significant difference in complication rates between consultants (6 complications in diabetics and 8 in non-diabetics) and ophthalmic residents (11 and 21 respectively), (X^2=0.05, p=0.8). During the follow up period, 6 (6.7%) in group A required a YAG posterior capsulotomy for opacification, compared to 2 (7.1%) in group B, 8 (8.9%) in group C, and 3 (10.7%) in group D. There was no significant difference in YAG capsulotomy rates between diabetic and non-diabetic patients (X^2=3.6, p=0.057).

Visual results

The median pre-and postoperative visual acuities for the patients in each of the four groups are shown in Table III. Overall the visual improvement in non-diabetics was better than diabetic patients (sign test, X^2=7.6, p=0.006). This was due to a better improvement amongst non-diabetic patients undergoing phacoemulsification (sign test, X^2= 5.3, p=0.02) . There was no significant difference in visual improvement between diabetics and non-diabetics undergoing ECCE (sign test, X^2=3.2, p=0.07).

In group A, of the 78 patients who had no retinopathy before surgery, 63 (80.8%) obtained a vision of 6/12 or better, 5 (6.4%) a vision of 6/18 or 6/24, 6 (7.7%) a vision of 6/36 or 6/60, and 4 (5.1%) a vision worse than 6/60 (2 of these were due to diabetic maculopathy and 2 due to the sequelae of proliferative retinopathy). Out of the 8 patients who had background retinopathy (without maculopathy) before surgery, 5 (62.5%) obtained a vision of 6/12 or better, 1 (12.5%) a vision of 6/18, 1 a vision of 6/36, and 1 a vision of CF (due to maculopathy). Of the 3 patients who had clinically significant maculopathy before surgery, 2 (66.7%) obtained a vision of 6/18 or 6/24, and 1 (33.3%) a vision of CF. The one patient with proliferative retinopathy before surgery had a final vision of HM following treatment (same as preoperative vision).

In group B, of the 14 patients who had no retinopathy before surgery, all obtained a vision of 6/12 or better. Of the 8 patients who had background retinopathy (without maculopathy) before surgery, 4 (50%) obtained a vision of 6/12 or better, 2 (25%) a vision of 6/18 or 6/24, and 2 (25%) a vision of CF (one was due to maculopathy and the second patient was unchanged

TABLE IV - THE PRE- AND POSTOPERATIVE STATUS OF DIABETIC RETINOPATHY (DR) IN BOTH GROUPS A AND B. THE DETAILS OF THE UNOPERATED FELLOW EYE ARE ALSO PRESENTED

		ECCE (Gp A, n=90)		Phaco (Gp B, n=28)	
		Operated eye	**Fellow eye**	**Operated eye**	**Fellow eye**
Preop.	No DR	78 (86.7%)	72 (80%)	14 (50%)	17 (60.7%)
DR	Bkgd	8 (8.9%)	11 (12.2%)	8 (28.6%)	5 (17.9%)
Status	Mac	3 (3.3%)	5 (5.6%)	5 (17.9%)	5 (17.9%)
	PDR	1 (1.1%)	2 (2.2%)	1 (3.6%)	1 (3.6%)
Postop.	No DR	64 (71.1%)	66 (73.3%)	13 (46.4%)	16 (57.1%)
DR	Bkgd	16 (17.8%)	15 (16.7%)	6 (21.4%)	6 (21.4%)
Status	Mac	7 (7.8%)	6 (6.7%)	4 (14.3%)	5 (17.9%)
	PDR	3 (3.3%)	3 (3.3%)	5 (17.9%)	1 (3.6%)

(No DR = No diabetic retinopathy present, Bkgd = Background diabetic retinopathy, Mac = Diabetic maculopathy, PDR = Proliferative diabetic retinopathy)

TABLE V - PROGRESSION OF RETINOPATHY (DR)

	ECCE (90)		Phaco (28)	
	Operated eye	**Fellow eye**	**Operated eye**	**Fellow eye**
No DR -> Background	9 (10%)	5 (5.6%)	1 (3.6%)	1 (3.6%)
No DR -> Maculopathy	3 (3.3%)	1 (1.1%)	0	0
No DR -> Proliferative	2 (2.2%)	0	0	0
Bkgd DR -> Proliferative	0	1 (1.1%)	4 (14.3%)	0

from their preoperative vision due to amblyopia). Out of the 5 patients who had clinically significant maculopathy before surgery, 4 (80%) obtained a vision of 6/12 or better, and 1 (20%) a vision of CF. The one patient with proliferative retinopathy before surgery had a final vision of 6/36 following treatment (was CF preoperatively).

If the visual results from groups A and B are combined, 84% of those with no preoperative retinopathy achieved a postoperative acuity of 6/12 or better, compared to 56% of those with background retinopathy, and 50% of those with clinically significant maculopathy.

Overall, postoperative vision was better than preoperative vision in 97 diabetics compared to 109 control patients. Hence the odds risk ratio of a diabetic patient gaining an improvement in vision following surgery compared to a non-diabetic patient is 0.89:1 (subanalysis shows ratios of 0.9 and 0.86 for ECCE and phacoemulsification respectively). Overall, postoperative vision was worse than preoperative vision in five diabetics compared to one control patient. Hence the odds risk ratio of a diabetic sustaining visual loss following surgery compared to a non-diabetic patient is 5:1 (this could not be subanalysed as no patient in group D had a worsening of vision).

Diabetes control was checked by measurement of the patients' preoperative random blood glucose. The mean glucose was 11.4 mmol/L (SD 5.46) in those gaining a visual improvement, and was 11.6 mmol/L (SD 5.63) in those having poor postoperative vision or a worsening of retinopathy. These were not significantly different. In those having visual improvement, 26 diabetics were hypertensive, compared to 5 being hypertensive in the diabetics suffering poor visual outcome or a worsening of retinopathy. There was not a significant preponderance of hypertensives in this latter group.

Retinopathy results

The pre- and postoperative status of diabetic retinopathy in both groups A and B is shown in Table IV. The details of the unoperated fellow eye are also presented to show which changes may be attributable to the surgical procedure. This shows that following ECCE, 9

(10%) of the operated eyes progressed from no retinopathy to background changes (only 5 (5.6%) of the fellow eyes progressed), and that 3 (3.3%) of the operated eyes progressed from no retinopathy to a clinically significant maculopathy (only 1 (1.1%) of the fellow eyes so progressed). Two eyes (2.2%) without retinopathy preoperatively progressed to proliferative retinopathy following ECCE compared to none of their fellow eyes. No eyes undergoing ECCE progressed from background change to proliferative disease, unlike one (1.1%) fellow eye. Following phacoemulsification, one (3.6%) operated and its fellow eye changed from no retinopathy preoperatively to background changes (without maculopathy). However, 4 eyes (14.3%) progressed from background retinopathy to proliferative disease unlike their fellow eyes which showed no change in retinopathy status. Overall, cataract surgery was found to lead to a worsening in retinopathy in 19 operated eyes compared to a worsening in 8 fellow eyes. This was statistically significant (McNemar test, X^2=4.3, p=0.04). However, ECCE was no more likely to cause worsening of retinopathy than phacoemulsification (X^2=0.03, p=0.87).

DISCUSSION

As with all aspects of medicine, it is important to be able to provide patients with as much information as possible regarding their prognosis following surgical intervention, and this is particulary so for cataract surgery where there is the potential risk of visual loss. We feel that our groups of diabetic patients and non-diabetic controls are well matched to allow us to draw reliable conclusions from our data. 13% of cataract surgery performed during the study year was performed for diabetic patients, and this is probably slightly higher than in other institutions, where about 10% of all cataract surgery is thought to be in diabetic patients (1). Mortality was similar between the diabetic and non-diabetic groups (three and two deaths in the years following cataract surgery).

Unfortunately the precise aetiology of the pathophysiological processes involved in onset and progression of retinopathy still requires elucidation. IGF-1 may play a possible role in the worsening of diabetic retinopathy (10), and intravitreal injections of this substance leads to vasodilation, microaneurysm formation and neovascularisation (11). Pituitary ablation was associated with an improvement in proliferative retinopathy and a reduction in IGF-1 values (12). Various iatrogenic factors including surgical trauma leading to a breakdown in the blood retinal barrier, a change in the ratio of inhibitory to angiogenic factors and the release of inflammatory mediators have been proposed. An intact posterior capsule is thought to reduce the progression of diabetic retinopathy as loss of this capsule may allow freer movement of factors between the posterior and anterior segments of the eye (2).

Our diabetic patients do seem to achieve a satisfactory level of visual improvement, and this is in keeping with other authors (4, 7, 8, 13). We chose to study patients who underwent surgery in 1995 as this would allow an adequate postoperative follow up, and this time span is recent enough for there to not have been any major technological advances. The only change would be that nowadays more diabetics undergo phacoemulsification as this procedure gains more acceptance, and also for there to be fewer complications associated with it as more surgeons advance along the learning curve. If anything, this factor would also have improved the outcome of our controls as fewer complications may have occurred. Table 1 shows that diabetic patients undergoing phacoemulsification were slightly younger than those undergoing ECCE, and this probably implies case selection bias at the time of surgery with perhaps the younger patients having less dense cataracts or thought to have a better prognosis.

Although there was no difference in complications between the non diabetic and diabetic groups undergoing ECCE (p=0.2), there were significantly more complications in the non-diabetic patients undergoing phacoemulsification compared to diabetics undergoing phacoemulsification (p=0.046). The rate of posterior capsule rupture amongst the non-diabetics was higher but did not reach statistical significance (p=0.06). It is much more beneficial for diabetic patients that an intact posterior capsule be maintained for the reasons alluded to earlier, and because vitreous loss does lead to a poorer outcome (14).

Although more senior surgeons (consultants) elected to operate on the diabetic patients, perhaps

due to the greater assumed risks of cataract surgery in diabetics, the complication rate amongst ophthalmic residents (under the supervision of the consultant) was not greater (p=0.8). We would therefore suggest that any difference in surgical skills between different grades of ophthalmologists did not bias the results towards either the diabetic or non-diabetic group.

The requirement for YAG posterior capsulotomy was higher in the diabetic patients but this was not statistically significant (p=0.06). This statistical result may of course have been different with increased patients numbers or a longer follow up, but does seem to be similar to the findings of Ionides et al where overall there was no difference between diabetics and non-diabetics (15).

Overall the visual improvement in diabetic patients is not quite as good as in non-diabetic patients, as is the chance of obtaining the same amount of final visual improvement (0.89:1). Of greater concern is that diabetic patients are five times more likely to suffer a worsening of vision following surgery. Patients need to be warned of this preoperatively. The severity of retinopathy and maculopathy prior to cataract surgery in diabetic patients are the major determinants of postoperative visual acuity (16). Our results agree with this, and show that 84% of patients without retinopathy are more likely to achieve a postoperative vision of 6/12 or better, compared to 56% of those with background retinopathy, and 50% of those with clinically significant maculopathy. Visual loss may be compounded in the long term by the increase in diabetic retinopathy caused by the surgery itself (p=0.04), with both phacoemulsification and ECCE equally likely to cause worsening (Tables IV and V). Data on the progression of the fellow unoperated eye allows us to postulate the worsening caused by the surgery itself, but again we are unsure as to why there should be a far greater progression from background to proliferative retinopathy following phacoemulsification than ECCE, and a greater initiation of retinopathy (background, maculopathy and proliferative) from no preoperative retinopathy following ECCE.

Phacoemulsification should technically be a better operation for diabetic patients as there is a much lower rate of preoperative and postoperative complications, reduced intraocular inflammation, minimal iris trauma and a rapid visual rehabilitation. As the section is small and aqueous tight, it is possible to safely perform retinal laser immediately or soon after surgery if it is required. Progression of retinopathy has previously been found to be related to poor glycaemic control, a longer duration of diabetes, insulin treatment (7) and the presence of retinopathy at baseline (7, 13). In our study, there was no significant difference in preoperative diabetes control between those patients that had a good result from surgery, or in those that had a poor visual result or a worsening of retinopathy (mean random blood sugars of 11.4 and 11.6 mmol/L respectively). Random blood sugar is not the most useful measurement of overall diabetes control, and ideally all patients should have undergone a measurement of long term glycaemic control (eg. HbA1C or fructosamine). As these investigations were not available for all of our patients, it was not possible to analyse these results meaningfully. In addition, as our department performs surgery for diabetics who undergo general medical care at several surrounding sites, we were unable to obtain information regarding diabetes duration for all of our patients.

Ideally, a large (multicentre) prospective randomised trial of ECCE versus phacoemulsification in diabetic patients is required to better elucidate these questions of visual improvement and retinopathy progression. This of course requires the premise at the outset that phacoemulsification and ECCE are both equally efficacious procedures in this group of patients. A trial of this type would also allow us to compare the visual results in diabetic patients with different degrees of retinopathy, so that we may counsel those in whom we would not expect surgery to offer any useful visual improvement.

In conclusion, we would advise our diabetic patients due to undergo cataract surgery that a) they have a good chance of visual improvement but to a level less than if they were not diabetic, b) they have a greater chance of visual loss, c) surgery may initiate or worsen any pre-existing retinopathy and this may affect their vision in the future. Postoperative monitoring should be frequent and regular so that any worsening of retinopathy may be diagnosed early and treated as appropriate. In the event of any untoward complications, referral to a diabetic retinal specialist should be initiated at an early stage.

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