The effect of diabetic control on the incidence of, and changes in, retinopathy in type 2 non-insulin dependent diabetic patients

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SUMMARY
The purpose of this study was to investigate the association between retinopathy and the levels of diabetic control found in type 2 non-insulin dependent diabetic patients. The study covered a four-year period and used retrospective, routinely recorded general practice and optometry records from 260 patients; those with retinopathy (n = 38) and those without retinopathy (n = 222). The study demonstrated a strong relationship between the presence of retinopathy and long-term diabetic control as measured by glycosylated HbA1$_c$, disease duration and, to a lesser extent, the level of urine microalbumin. Blood pressure, cholesterol, body-mass index, and smoking status showed little association with the presence of retinopathy. We conclude that retinopathy, assessed by community optometrists, is a significant correlate of poor diabetic control.
Keywords: *type 2 non-insulin dependent diabetes; retinopathy; primary care; optometrist.*

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Introduction

RESEARCH into retinal changes in diabetes mellitus has been carried out primarily in young type 1 diabetic patients and has documented the relationship between glycaemic control and the development of retinopathy.[1,2] Results from work in type 2 diabetes have been equivocal; the only generally accepted principle is that diabetic retinopathy is affected by the level of diabetic control.[3,4] These studies were primarily concerned with the latter stages of retinopathy and the prevention of sight loss; variations at earlier stages are not well documented. Shared-care schemes in the United Kingdom (UK) mean that optometrists are involved in the early management of diabetic patients. If it could be demonstrated that early changes in non-insulin dependent diabetic retinopathy mirrored some of the factors affecting the progress of diabetic disease, then the eye report from the optometrist could be relevant to the general care of the diabetic patient.

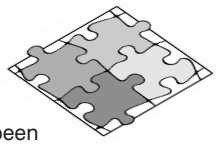
Method

The setting was a market town in Staffordshire, UK and was based on a retrospective review of local primary care optometrists' and general practitioners' (GPs') records. The optometric diabetic register was searched from its commencement in 1996, to select patients attending either of the two participating optometric practices and who were registered with one of five medical practices in the town. Any patients recorded as insulin dependent were excluded.

Two diabetic specialist nurses transferred data from the patient's general practice diabetic records, including glycosylated HbA1$_c$, blood pressure (systolic and diastolic), body-mass index (BMI), cholesterol, and urinary microalbumin. The method of diabetic control (medication or diet) and duration of diabetes were also recorded. Where the method of control changed over the study period, the most recent was used in the analysis.

Optometric data were extracted for each visit carried out under the local diabetic shared-care scheme. The retinal examinations had all been performed with dilated pupils and information recorded for the right and left eyes, and for the background and macular areas. All the records were reviewed and a simple scoring system devised, which enabled separate scoring for background and macular areas of the retina together with an overall score for each eye (Table 1). Any record containing retinal changes was re-scored by a second practitioner who was blinded to the first score.

HOW THIS FITS IN



What do we know?

A strong relationship between glycaemic control and retinopathy has been documented in type 1 diabetic subjects. The findings in type 2 diabetes have been equivocal.

What does this paper add?

Results have suggested that retinopathy, as detected and assessed by community optometrists, is a significant correlate of poor diabetic control in type 2 diabetic subjects. Future research might investigate how general practice and optometric records can be combined to aid development of 'best practice'.

As multiple records for an individual patient were not independent, there would be correlation in both the outcome measure (i.e. retinopathy status) and explanatory variables within patients over time. To allow for this within-patient correlation, the outcome data were 'aggregated' and a single outcome was assigned to each individual. Patients with at least one record of retinal changes were classified as belonging to the 'retinopathy' group and the patients without any retinal changes were classified as belonging to the 'comparison' group. As the biological measures were recorded at each GP visit, the arithmetic mean of the values recorded over the study period was calculated for each patient.

Comparisons between the two retinal status groups were made. For categorical data, percentages were calculated and compared using the χ^2 test. For numerical data, appropriate summary measures and two-sample tests were calculated. To examine independent effects, logistic regression was used to build an age–sex adjusted multivariate model. Analysis was carried out using Stata 6.0.

Results

Permission was given for access to medical records by 302 patients with 260 included in the record review (exclusions: no GP data [n = 38] and insulin dependent [n = 4]). Retinal changes were recorded in 38 patients; 222 patients remained free of retinopathy. The cohort was 57% male and had an age range of 28 to 98 years (median = 70 years); the age and sex distributions were similar in the two groups.

Different numbers of records were available on individual patients for two reasons: non-attendance for optometric or medical examination, and patients developing type 2 diabetes during the study period. The maximum number of records was six and distribution was similar in the two groups, although the median number was higher in the retinopathy group (four) than in the comparison group (three).

All but one patient with retinal changes controlled their diabetes by oral medication, compared with 70% in the comparison group. A higher median value of glycosylated $HbA1_c$ (8.0%) was recorded for those with retinal changes, compared with those without (7.1%). When dichotomising the $HbA1_c$ level at 6.9%, as recommended by Diabetes UK, a significantly greater proportion of those with retinal changes had a value above this point (79% versus 56%). Those with retinopathy had significantly longer disease duration (72 compared with 48 months) and higher median urinary microalbumin levels (9.5 compared with 7.8 mg/l); this latter finding was not statistically significant. No difference in cholesterol, blood pressure, or BMI was seen between the two groups. A two-factor model (disease duration and glycosylated $HbA1_c$ level) was applied to the data, adjusted for age and sex (Table 2). Patients with either a $HbA1_c$ level greater than 6.9% or disease duration longer than four years were three times more likely to have retinal changes.

Discussion

This study suggests that poor diabetic control and disease duration can identify the group of non-insulin diabetic patients in the community with the highest likelihood of retinopathy. For the first time we have been able to show that mild retinopathy identified during routine optometric examination in community practice correlates with diabetic control. However, the study was retrospective and some data were incomplete, which affected the power of the study. This was particularly true of the medical data collected from the general practices. While $HbA1_c$ levels and blood pressures were available for all patients, several of the secondary measurements were not.

The setting for this study was in primary care, using practitioners and their routinely collected records. The reliability of scoring the fundoscopy records between optometrists was good; scoring did not differ between the two practitioners by more than one point. This illustrates that practitioners are making measurements of fundal changes that are valid, reliable, and which correlate with measures of diabetic con-

Table 1. Scoring system used for grading severity of retinal changes.

Grade	0	1	2	3	4
Microaneurysms or dot haemorrhages	None	1–2[a]	3–4[a]	5–6[a]	>6[a]
Blot haemorrhages	None	1–2[a]	3–4[a]	5–6[a]	>6[a]
Exudates — number of foci	None	1–2[a]	3–4[a]	5–6[a]	>6[a]
Exudates — cumulative area	None	<1¼₄₄ optic disc area	1¼₄₄–1½₄₂ optic disc area	1½₄₂–3¼₄₄ optic disc area	>3¼₄₄ optic disc area
Cotton-wool spots	None	1–2[a]	3–4[a]	5–6[a]	>6[a]
Intra-retinal micro-vascular anomalies	None				Present
New vessels	None				Present
Pre-proliferative	None				Present
Proliferative	None				Present

[a]Number of lesions.

Table 2. Multivariate analysis: retinal changes versus comparison.

Characteristic	Frequency (%)		Multivariate odds ratio[a] (95% CI)
	Retinopathy	Comparison	
Sex			
Male	10 (43)	72 (44)	1.00
Female	13 (57)	91 (56)	1.07 (0.4–2.7)
Age (years)			
28–65	8 (35)	58 (36)	1.00
66–73	10 (43)	47 (28)	1.36 (0.5–3.9)
74–98	5 (22)	58 (36)	0.44 (0.1–1.5)
Disease duration			
≤4 years	7 (30)	88 (54)	1.00
>4 years	16 (70)	75 (46)	2.88 (1.1–7.7)
Glycosylated $HbA1_c$			
<6.9%	5 (22)	69 (42)	1.00
≥6.9%	18 (78)	94 (58)	2.73 (0.9–7.9)

[a] Adjusted for age, sex, and the two main effects.

trol. Such a scoring system may be valuable in routine practice until retinal photography or imaging is commonplace and has been demonstrated to be cost-effective.

The UK Prospective Diabetes Study (UKPDS)[4] looked at the relative effects of 'intensive' as opposed to 'conventional' treatments for type 2 diabetes on the eye and demonstrated a significant influence on retinal changes beyond a six-year period. The findings from our study were that patients who are controlled by diet only are extremely unlikely to have any retinal changes, as compared with patients on oral therapy. Those controlled by oral medication, but with no retinopathy, had $HbA1_c$ levels closer to those subjects in the retinopathy group.

The level of retinopathy detected (14.6%) appears to be significantly less than in other studies (typically 20%).[3,4] While this percentage may indicate under-ascertainment of retinopathy in our study, other contributory factors are: (a) exclusion of insulin-dependent diabetics; (b) non-inclusion of those with retinopathy requiring treatment who are being managed outside the shared-care primary care scheme; (c) a better-than-average level of diabetic control in the studied population (median blood pressure = 147/82 and median $HbA1_c$ 7.2%; both approach the UKPDS standard for 'tight' control); and (d) the requirement to 'opt in' to the study.

There was a very wide range of values for urinary microalbumin levels and only two general practices measured it routinely. The importance of this measure is that, like retinopathy, it reflects microvascular changes which lead to ischaemia and eventual neo-vascularisation.[5] Our non-significant finding of an association with retinal changes suggests that research into the significance and usefulness of microalbumin measurements in general practice should be carried out.

The study has suggested that retinopathy assessed by community optometrists is a significant correlate of poor diabetic control. Future research should now investigate, in a prospective manner, how GP records of diabetic control and optometric records of the ocular fundus can be combined to aid the development of 'best practice'.

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