Blindness in patients with diabetes who have been screened for eye disease

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Abstract

Purpose **Detection of diabetic retinopathy by screening is a major public health concern. Fundus photography has been shown to be a useful screening tool for the detection of diabetic retinopathy. In this paper the authors assess the incidence of blind and partially sighted registration due to diabetic eye disease in patients screened by a mobile fundus photography unit and identify the factors that contributed to loss of vision in the registered group.**

Methods **A retrospective review of blind and partially sighted registrations between 1990 and 1995 was performed in a diabetic population screened by a mobile fundus photography unit in a region with a population of 390 000. The incidence of blind and partially sighted registration in the screened diabetic population was calculated. In the registered group, cause of visual loss, accuracy of photograph reporting, delay in laser treatment, adequacy of laser treatment and non-attendance rates at ophthalmic clinics were assessed.**

Results **Of the 5390 patients screened by the mobile unit over 6 years, 68 (210 per 10^5 patient-years) were registered blind or partially sighted, but in only 17 patients (53 per 10^5 patient-years) was this as a result of diabetes. The factors contributing to loss of vision were found to be failure of laser treatment, rapidly progressive disease and poor patient attendance.**

Conclusions **As the majority of visual impairment in patients with diabetes is not due to diabetic retinopathy, this has important implications for screening programmes and may make the St Vincent Declaration targets difficult to achieve. The rate of new blind and partially sighted registration due to diabetes in the screened population was low at 53 per 10^5 patient-years (95% confidence interval, 29–76).**

Key words Blindness, Diabetes, Photography, Retinopathy, Screening

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Diabetic retinopathy is believed to be the commonest cause of blindness between the ages of 16 and 68 years in the United Kingdom and the main cause of blindness in patients with diabetes.[1,2] We wished to study the records of patients who had been screened by the Tayside mobile unit in its first 6 years of operation and who had subsequently required certification for defective vision (Scottish forms BP1 and BP2 for blind and partially sighted registration respectively). Our objective was to assess the incidence of blind and partially sighted registration in diabetic patients attending the mobile screening unit, to look for causes of visual loss and for defects in the screening system that may have contributed to loss of vision in these patients.

Fundus photography can be a useful screening tool for the detection of diabetic retinopathy.[3–8] A number of mobile units[9] are currently in operation throughout the United Kingdom and optometry-based schemes[10,11] may also be effective. Locally there is a mobile fundus photography unit that has previously been shown to be effective.[12,13] We used this well-characterised population to address the issues outlined above.

Methods

Tayside region has a population of 390 000 with an estimated diabetic population of 7596 (1.94%).[14] For the purposes of BP1 and BP2 registration, blindness is defined as Snellen visual acuity below 3/60 and partial sight as visual acuity between 3/60 and 6/60, with visual field loss being an additional qualifying factor in the presence of better acuity. All BP1 and BP2 registrations for the Tayside region between 1 January 1990 and 31 December 1995 were reviewed and, by consulting the mobile screening unit database, those patients who had attended the mobile unit during this time but prior to BP1 and BP2 registration were identified. Retrospective data regarding these patients was obtained from the screening unit database and from examining the patient

hospital medical records. Details of the mobile fundus photography screening programme in Tayside have been described previously.[12,13]

The patients' age, sex, duration and type of diabetes, smoking history and pre-existing hypertension history were noted. Insulin-dependent diabetes was defined if diagnosis was made at less than 35 years of age and the patient was on insulin. The number of patients already attending a hospital-based ophthalmic clinic prior to attending the mobile screening clinic was recorded. Retinal photographs from the mobile unit camera are normally categorised by consultant diabetologists, but for this study, patients' photographs were re-examined by a consultant ophthalmologist and graded using the same system as that already used (grades: 0 = no abnormality, 1 = background changes, 2 = maculopathy or proliferative retinopathy requiring referral to ophthalmology clinic, 3 = non-diabetic eye disease, 4 = cataract and unreadable).[13] The accuracy of the original reports was then evaluated. In patients requiring referral to an ophthalmic clinic on the basis of the photograph report, the time interval between these two events was recorded.

For each patient now BP1 or BP2 registered, the condition causing visual loss was recorded, and the contribution of diabetic eye disease to visual impairment where appropriate was noted, i.e. presence of maculopathy, tractional detachment, vitreous haemorrhage, etc. This information was obtained from hospital notes. The hospital treatment received by the BP1 and BP2 registered patients prior to registration was assessed with regard to number of eyes requiring cataract extraction, vitreoretinal surgery or laser treatment. The time delay in the application of laser treatment and the number of missed ophthalmology clinic appointments was recorded.

Incidences within the screened population are given with 95% confidence intervals, which are calculated by assuming a normal distribution to calculate the standard error. The incidence of blindness is presented as the number of cases per 10^5 patient-years, to allow comparison with other large studies in which this method was used.

Results

The total number of patients screened in the mobile unit over the 6-year period was 5390. The number of BP1 and BP2 registrations between 1990 and 1995 was 1526, and of these 68 had previously had retinal photographs taken by the mobile screening unit (in those who had had multiple screening episodes, the most recent screening date which determined registration was taken). Using 5390 diabetics extracted from a known population of 7596 diabetics as the denominator, this represents an incidence of registration for blindness and partial sight of 210 per 10^5 patient-years (95% confidence interval (CI), 160–260). Four sets of patients' hospital medical records were unavailable. Of the remaining 64 patients whose records were retrieved, the cause of loss of vision was diabetic eye disease in 17, which represents 1% of all BP1 and BP2 registrations for the 6-year period and 0.3% of all the diabetic patients screened by fundus photography during the same period. This represents an incidence of registration for blindness and partial sight in diabetic patients which is due to diabetes of 53 per 10^5 patient-years (95% CI, 29–76). The remaining 47 diabetic patients (73.4%) were registered blind or partially sighted for reasons other than diabetic eye disease (Table 1).

BP1 and BP2 registrations due to diabetic eye disease

In all patients the ophthalmologist agreed with the photograph grading by the diabetologist. In the group of 17 patients with visual impairment due to diabetic eye disease, the median age was 66 years (range 27–86 years); 11 were female (65%) and 6 male (35%). Three patients (18%) had insulin-dependent diabetes; 14 patients (82%) had non-insulin-dependent diabetes among whom 1 was treated by diet alone, 7 were on tablets and 6 were treated with insulin. The median duration of known diabetes at the time of BP1 and BP2 registration was 10 years (range 1–34 years); 7 patients (41%) had hypertension and there were 4 smokers (24%).

Three of the patients were registered blind (aged 27, 60 and 76 years) and 14 partially sighted (median age 66 years, range 56–86 years), representing a 6-year incidence of 0.03% and 0.26% respectively of the total population screened. The reasons for the visual loss in these patients are shown in Table 1.

Thirteen patients (76%) were already attending an ophthalmic out-patient clinic when screened by the mobile unit but all were correctly identified by fundus photography as patients who would have needed referral. Of the remaining 4 patients (24%), 2 were identified by photography (first visit) but failed to respond to early treatment, one repeatedly failed to attend the ophthalmology clinic over a 4-year period, and

Table 1. *Reasons for BP1 and BP2 registration*

Non-diabetic causes (47 patients)	Eyes	Diabetic causes (17 patients)	Eyes
Age-related macular degeneration	58	Maculopathy (n = 2 blind)	27
Primary open angle glaucoma	28	Tractional detachment (n = 1 blind)	4
Myopic degeneration	4	Vitreous haemorrhage	2
Anterior ischaemic optic neuropathy	2		
Visual field loss secondary to stroke	2		
Total eyes	94	Total eyes	33

one (patient A) was identified, correctly, as having background retinopathy but a year later developed untreatable maculopathy.

A total of 70 patients (1.3%) screened by the mobile unit over the 6-year period received laser treatment for their diabetic eye disease. Analysis of the hospital treatment received by the 17 patients registered blind or partially sighted due to diabetic retinopathy revealed that out of 33 eyes (1 patient was uniocular) 29 eyes (88%) had retinal argon laser treatment, with 21 eyes receiving macular laser (either grid or focal) and 13 eyes undergoing panretinal photocoagulation. The laser treatment carried out followed the recommendations of the ETDRS studies.[15,16] Of the 29 eyes that had laser treatment, 17 (58%) were treated within 4 weeks of listing for treatment, 6 (21%) waited between 4 and 8 weeks and 6 (21%) were treated more than 8 weeks from the date of listing. Twelve eyes (36%) had cataract surgery and 5 (15%) had a vitrectomy procedure. Of all patients being treated with laser ($n = 70$), BP1 or BP2 registration was prevented in 57 at 6-year follow-up (81% success).

The rate of missed appointments at the ophthalmic clinic was 24% in the BP1 and BP2 registered group compared with a rate of 13% in the total ophthalmic clinic population ($p < 0.05$, chi-squared test). The average number of missed hospital appointments per year ranged from 0 to 1.8 (mean 0.8), with half of the patients having missed at least one appointment per year.

Discussion

The incidence of blind and partially sighted registration amongst diabetic patients was 210 per 10^5 patient-years. However, the majority of registrations were due to non-diabetic causes (73.4%). The incidence of registration due to diabetes was 53 per 10^5 patient-years, with only 18% being registered as blind, and the remainder being partially sighted.

Previous studies report a blind registration rate of up to 2% per annum in diabetic patients,[17–21] although the rate *due* to diabetes may be lower at 66–81 per 10^5 patient-years.[22,23] A further study quotes an incidence of blindness of 410 per 10^5 patient-years in patients with diabetes, but in 320 per 10^5 patient-years there was no diabetic retinopathy.[18] By implication, blindness attributable to diabetes probably had an incidence of 90 per 10^5 patient-years at most. The estimation of registration for visual impairment is thus broadly similar between our study and other recent publications (53–90 per 10^5[18,22,23]). The German studies[22,23] used an estimate of the diabetic population from another region in Germany, which may not be accurate. Our study has a much better defined diabetic population, and although this group was self-selected because they attended for screening, it does represent 71% of the total diabetic population in the region[14] and is thus reasonably representative of the total diabetic population. In a diabetic population with more elaborate but more limited ($n = 754$) screening, blindness registration occurred in 100 per 10^5 patient-years.[24] Completeness of blindness registrations may vary between regions, which may partly explain the difference in diabetes-related blindness rates between Tayside and other areas.[18,22–24]

It was previously reported that 34% of diabetic patients had non-diabetic causes of blindness.[23] However, we report that 73% of BP1 and BP2 registration was not due to diabetes. In Dwyer *et al.*'s study[18] it can be calculated that 78% of diabetics registered blind had no retinopathy, indicating that at least 78% were blind due to non-diabetic causes. It appears that the majority of blindness in patients with diabetes is probably not due to diabetes. The failure of health services to prevent blindness in diabetic patients led to the St Vincent Declaration (1989),[25] which pledged to reduce new cases of diabetic blindness by one-third or more within 5 years. If much of this blindness is not due to diabetes it may be difficult to achieve this target.

A number of factors contribute to the prevention of visual loss. Prevention of development and progression of diabetic eye disease by good glycaemic and blood pressure control and avoidance of smoking are important. However, once treatable eye disease has developed early detection and treatment is essential and we determined why there was a failure to prevent visual loss in the 17 patients who were BP1 and BP2 registered.

The photograph reporting was found to be 100% accurate. Although there were 3 technically inadequate photographs in patients who subsequently became blind, no delay in treatment resulted since these patients were already attending an ophthalmology clinic. Inadequacy of the camera system as a screening tool did not appear to be responsible for visual loss in any patient with the possible exception of patient A. However, it should be noted that fundus cameras used for screening do not employ high-magnification stereophotography and therefore cannot reveal retinal oedema but rather depend on the presence of hard exudates and haemorrhages within the macular area to identify maculopathy. Changes in visual acuity may be useful in such circumstances. In addition, failure to prevent loss of vision could not be attributed to organisational delays in laser treatment as most patients in this study had laser treatment carried out within 8 weeks of diagnosis.

Poor attendance at a diabetic clinic is associated with poorer long-term outcome and increased prevalence of diabetic complications.[26] In this study the level of poor attendance was found to be high among the BP1 and BP2 registered group, with the rate of missed appointments at the ophthalmic clinic being almost twice that of the total ophthalmic clinic population, thus highlighting the need for better patient education. One patient failed to re-attend for screening for 4 years, by which time rapidly progressive diabetic eye disease had developed.

During the 6-year period, 70 patients screened by the mobile unit received laser treatment for their diabetic eye disease and with 13 of these subsequently requiring BP1 and BP2 registration, this represents a success rate for laser of 81%, with maculopathy being the cause of visual loss in the majority (Table 1). This is similar to or better than published results[27,28] for success of laser treatment

in diabetic eye disease. Failure of laser treatment is the cause of visual loss in the majority of patients, especially those with maculopathy. It remains likely that despite the best screening methods and optimum treatment, some patients will have progressive retinopathy leading to visual impairment.

In this study, comprehensive data were unavailable for unscreened diabetic patients, and therefore we were unable to compare the incidence of visual loss in the screened and unscreened diabetic population.

In summary, non-diabetic eye disease accounted for the majority of visual loss in our screened population (73%), which may make the St Vincent Declaration target difficult to achieve. Causes of registration for visual impairment due to diabetic eye disease were failure of laser treatment, rapidly progressive disease and poor patient attendance. Although adequate screening is an important factor in realising the goals of the St Vincent Declaration, it is clear from our study that while efficient and prompt laser therapy may reduce its incidence, screening will not eradicate blindness in the diabetic population.

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