MASS SCREENING FOR DIABETIC RETINOPATHY- A REPORT ON DIABETIC RETINAL SCREENING IN PRIMARY CARE CLINICS IN SINGAPORE

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ABSTRACT

***Introduction** – Mass screening for diabetic retinopathy is expensive and inaccessible if done by institutional ophthalmalogists. Most diabetics are seen in primary care. Hence it is logical to provide mass screening in primary care clinics. In Singapore, government polyclinics are ideal centres of screening as they are well organised and accessible to the community.*

***Screening Method** – An effective mass screening strategy must provide wide coverage, be low cost and have the ability to assess diabetic eyes accurately and quickly. Non-mydriatic fundal photography was used as the screening method. Mass coverage was achieved by rotating two cameras around six government polyclinics. Cost was reduced by training existing staff and organising the programme to provide a high turnover of screenees. The photographs were read by ophthalmologists in a government-owned hospital. Patients that required referral were referred to specialist eye clinics.*

***Results** – A total of 13,296 patients were screened or rescreened during a period of 2 years (25 months). 2,911 patients or 21.8% of the total screened were found to have diabetic retinopathy. About half of these (10.8%) had sight threatening retinopathy. The most common sight threatening retinopathy was maculopathy (8.0%). Twenty-two percent of cases screened were referred. These include referral for other ocular conditions detected during the screening.*

***Conclusion** – Non-mydriatic fundal photography has proven to be both accessible and effective in screening diabetic eyes in urban Singapore and can be recommended for mass screening of diabetic eyes in the community.*

Keywords: *diabetes, diabetic retinopathy, prevention, retinal photography, low cost*

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INTRODUCTION

Diabetes is a growing problem in Singapore. Population surveys done in 1975, 1984 and 1992 showed an increasing prevalence from 2.0% to 4.7% to 8.6% respectively[1-3]. Although the methods used in the different surveys are different, the wide gap in the statistics and the ageing population of Singapore buttress this statistical trend as one of the risk factors of diabetes is age. Statistics for sex and age in the age band 30-69 years old was 12.4% for males and 11.5% for females in 1992[3].

Eye screening of diabetics

Diabetic Retinal Screening is essential in all NIDDM diabetics from the time of diagnosis because of the unknown duration of disease. In the National Health Survey conducted in Singapore in 1992, about half of the diabetics detected were not known to have diabetes before[3]. Studies of other diabetic populations have shown that up to 20% of non-insulin-treated diabetics have some diabetic retinopathy even at diagnosis, increasing to approximately 50% after a duration of 20 years or more[4]. Because of the greater proportion of NIDDM diabetics in a given population, they represent the major proportion of diabetics requiring ophthalmological care. Sight threatening retinopathy refers to maculopathy, preproliferative and proliferative retinopathy. Maculopathy is the most important sight threatening retinopathy in NIDDM type 2 diabetics in terms of frequency and therefore potential morbidity. The efficacy of local treatment with laser photocoagulation for both maculopathy and proliferative retinopathy is well established and should preferably be instituted before the onset of those retinal symptoms associated with significant visual loss[4]. A local screening programme done in a hospital diabetic population reported in 1990 by two medical units showed a prevalence of retinopathy in 38%, with sight threatening retinopathy in 17%[5]. In this article we present the results for the screening programme in government primary care clinics in Singapore.

Eye screening in government primary care clinics

A programme to screen diabetic eyes en masse in government primary health clinics was started on July 1991. This programme was initiated by a working committee who felt that existing screening techniques in primary health care at that time was inadequate for the following reasons:

1. Primary health care doctors were usually not skilled in the use of the direct ophthalmoscope.
2. A large number of diabetics were not screened for retinopathy. This resulted in a potential pool of patients that might become blind if they were not quickly detected and treated.

Government clinics treat a large number of diabetics. In 1991, 10.7% of attendances or 174,454 attendances seen in

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government primary care clinics were for diabetes[6]. This large pool of diabetics in government clinics was a key factor towards starting a viable screening programme. In 1992 there was an estimated 30,000 diabetics attending government polyclinics.

The method selected for diabetic retinal screening was by non-mydriatic retinal photography. This was chosen for the following reasons:

1. It did not require doctors to use a direct ophthalmoscope. Many diabetics were not screened because direct ophthalmoscopy was inconvenient, require pupillary dilatation of the eyes, a dark room and an experienced and enthusiastic physician.
2. Direct ophthalmoscopy requires considerable consultation time in a moderately busy primary care clinic. Many diabetics were not screened or were inadequately screened because of this.
3. There were not enough ophthalmologists to screen diabetic eyes if primary care doctors were to channel screening to the specialist eye clinics.
4. Photographic screening provided by the hospitals lacked accessibility and were inconvenient to patients. It would be better to extend the service to where the patients were.

The case for using non-mydriatic retinal photography for screening in primary care

Was there a better alternative than screening by non mydriatic camera? Mobile screening with non-mydriatic polaroid camera has been found to be effective in general practice[7]. It was felt that non-mydriatic retinal camera screening using polaroid photographs was the best form of screening because its relatively cheaper cost makes it viable as an effective mass screening programme. There are arguably more precise methods of screening[8] but in the Singapore context, it was felt that the other alternatives were not viable and were either too idealised to be achievable for mass screening, or too expensive or unattainable in the near term. It must be realised that this is not screening in a specialist clinic context where accuracy is sine qua non. This was a public programme where screening must be effective, low cost, fast and achievable on a mass scale. Non-mydriatic camera screening was considered a pragmatic solution to an urgent problem. Our statistics revealed that many with potential blindness were detected and referred for treatment and present a strong case for the use of non-mydriatic fundus photography. We are convinced that many of our diabetics are indeed better off because of this public programme.

Organisation of non-mydriatic retinal photography screening

In the Retinopathy Working Party Report which drew up a protocol for screening for diabetic retinopathy in Europe, it was recommended that the use for fundus photography be encouraged provided they are properly organised to (a) have the pictures quickly assessed by dedicated specialists and stored in the patient's records, (b) rapidly contact all patients in need of further assessment, (c) reassure and advise on next attendance the patients without retinopathy, and (d) inform their usual doctors. It was further recommended that screening should ideally be done by a dedicated ophthalmologist. However where this is not feasible because there are too many diabetic patients and not enough ophthalmologists, it is recommended that organisation of screening be the primary responsibility of the doctor in charge of the diabetic patients. Such collaboration should consist of (i) training and certification of the screeners involved; (ii) the establishment of channels for rapid referral of patients with sight threatening lesions. Other health providers can screen provided they are thoroughly trained, accredited and supervised in ophthalmic facilities. Experienced readers should evaluate retinal photographs. In all cases, the ability of these individuals to correctly detect retinopathy should be evaluated in a standardised fashion [9].

Organisation of the non-mydriatic retinal photography screening programme in primary care clinics in Singapore

A committee which comprised three primary health care doctors and an ophthalmologist decided in 1991 that the programme was viable and useful, and although it had its limitations, it was the best form of screening in the primary care context.

The screening programme was started from July 1991 and a 45 degree angle non-mydriatic camera (Topcon TRC-NW3 Non-mydriatic Retinal Camera) was acquired. The camera was operated by a trained junior photographic assistant (JPA) and a nurse who undertook the administrative and medical professional procedures. The camera was rotated around three polyclinics in the first year with different nurses operating in each polyclinic but the same photographic assistant taking the photographs. In July 1992, a second camera was started and this provided services to another three polyclinics. Another JPA was employed and more nurses were trained to run the programme in their respective polyclinics. A computer programme using DBase IV was used on personal computers to computerise the statistical findings. Data entry was done by nurses, and monthly and yearly statistical reports automatically generated by a programme written in DBase IV. Subsequently the programme was converted to Clipper, a fourth generation computer language that was related to the DBase software. Nurses were trained in the overall management of the Eye Screening Clinic. This include history taking, eye examination of patients, scheduling of appointments, computer data entry and generation of reports. The nurse supervised the local operation of the clinics and ensured that the logistics of the programme were properly handled.

The photographs were read by ophthalmologists based in a government-owned hospital. The logistics of despatching the photographs for reading and reporting, filing of reports and sending back reports to the requesting doctors were operated by designated nurses under the combined supervision of the polyclinic nursing sister, the doctor in-charge of the polyclinic and the doctor in-charge of the programme. Arrangements for reading and reporting by dedicated eye specialists were made between the specialist in-charge and the administrators. The logistics were standardised for all the polyclinics involved. The programme was monitored by monthly reports generated automatically through the computer programme by the nurse. Usually photographs done on patients were done with pupils dilated either by tropicamide or homatropine. Reversal of mydriasis was done by instillation with pilocarpine. Patients were forewarned of the problem of focussing after mydriasis. They were also warned of the possibility of acute glaucoma developing in the rare instance. This was done verbally as well as through a leaflet in English and the three main ethnic languages in Singapore. The quality of the photographs were excellent because of the investment in training and quality assurance to ensure that the programme got off the ground without any hitch. Within a few months the JPAs had acquired enough expertise to produce excellent polaroid photos as thousands of patients were screened. They were able to focus the camera to take excellent pictures rapidly even without mydriasis in many patients. These increased the number of photographs that could be taken daily and hence the productivity of the programme.

RESULTS

A report of the programme was analysed starting from June 1991 to July 1993. A time cleavage was defined from July 1992 as

this was the time the second camera began functioning.

From June 1991 to June 1992, a total of 5,313 patients were screened. There was a male:female ratio of 1:1.16. The majority of those screened were Chinese (70%), followed by Indians (15%), Malays (13%) and other races (2%). Most of the patients were referred from the government polyclinics (92%). There was a sizeable self referral rate from widespread dissemination of the programme through pamphlets and posters. The referral rate from general practitioners was low at 0.6% because at that time the programme was not actively advertised to general practitioners. This was because it was felt that a single camera was unable to take such a heavy load at its pilot debut. Subsequently when the second camera began functioning in July 1992, the programme was widely disseminated to general practitioners. Posters and pamphlets were sent to every general practitioner listed in Singapore. Subsequently referrals from general practitioners increased to 10% of total patients screened in the months July 1992 to June 1993. During this period, 7,983 patients were screened. The male:female ratio was 1:1.19; a figure almost unchanged from the preceding year. Most of the patients screened were in the age group 50 - 69 years old (61.4% of all screened), reflecting that the majority of diabetic patients were within those ages (Fig 1).

Fig 1 – Distribution of patients screened by age from Jun 91 to Jun 93

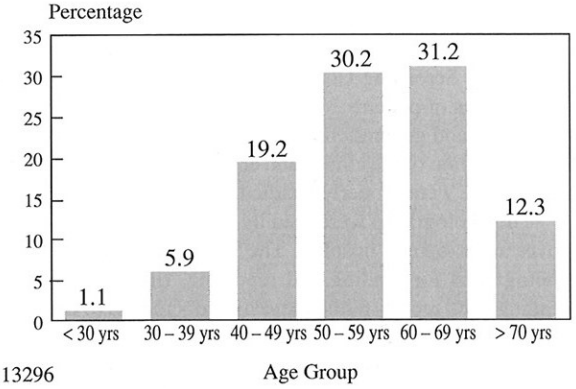

Table I showed distribution of diabetics by type of retinopathy from the screening programme. 24.2% of all screened from June 1991 to June 1992 had retinopathy in one or both fundal photographs. There were almost equal numbers of background retinopathy and maculopathy which were the two most common types of retinopathy: 11.0% and 9.9% respectively. As the programme entered its second year, the pattern of distribution of retinopathy showed changes. Background retinopathy (11.1%) was most common followed by maculopathy (6.8%). The pattern distribution change may be due to wider coverage of polyclinics and differing precinct patterns as well as the inclusion of higher numbers of general practitioner cases and repeat screenings. 15.2% of the diabetics screened in the second year were repeat screenings (compared to only 0.4% in the first year). All diabetics who were not referred to the specialist eye clinic would require a repeat screening annually or earlier for those with minor abnormalities. Table I shows the combined distribution of diabetics by type of retinopathy for the period June 1991 to June 1993. A total of 13,296 screenings were done during this two-year period. Of these, 1,233 were repeat screenings of which 1,221 were first repeat screenings. Only 11 diabetics had two repeat screenings.

In the first thirteen months of screening 13.2% had sight threatening retinopathy. In the next twelve months of screening, 9.3% had sight threatening retinopathy. Changes in patterns are expected during the initial years as there is a flush of cases with retinopathy who have never been screened or who were inadequately screened. When this initial crop of cases are referred and followed up at the specialist eye clinics, they leave behind the remaining who had normal photographs at the first screen or newly diagnosed cases or stragglers who had not been screened previously.

Table I - Distribution of diabetics by type of retinopathy in either or both eyes during the period June 91 to July 93

Type of retinopathy	No. of patient (%)		
	Jun 91 - Jun 92 (n=5,313)*	Jun 92 - Jul 93 (n=7,983)**	Jun 91 - Jul 93 (n=13,296)***
Background	584 (11.0)	884 (11.1)	1,468 (11.0)
Maculopathy	528 (9.9)	542 (6.8)	1,070 (8.0)
Preproliferative	125 (2.4)	144 (1.8)	269 (2.0)
Proliferative	41 (0.8)	37 (0.5)	78 (0.6)
Advanced	7 (0.1)	19 (0.2)	26 (0.2)
Total	1,285 (24.2)	1,626 (20.4)	2,911 (21.8)

*21, **1,212 and ***1,233 screenings were repeat screenings

Table II - Distribution of referred cases by time of of appointment requested during the period June 91 to June 93

Appointment category	No. of patient (%)	
	Jun 91 - Jun 92*	Jul 92 - Jun 93**
within one week	33 (3.7)	79 (4.3)
within two weeks	85 (7.7)	121 (6.6)
within four weeks	262 (23.8)	593 (32.5)
within eight weeks	349 (31.8)	492 (27.0)
within 3 months	261 (23.7)	376 (20.6)
within 6 months	104 (9.5)	166 (9.1)
indeterminate	5 (0.5)	0 (0)
Total	1,099 (100)	1,827 (100)

*20.7% and **22.8% of patients screened were referred.

Referral appointments for abnormal cases

The distribution of referred cases by time of appointment requested are given in Table II. Most of the referral categories fall within the period four weeks to three months. Referral categories reflect the urgency and immediacy of assessment and treatment. The more urgent the problem, the shorter the referral appointment indicated. Those requiring immediate treatment were recalled and sent to the specialist clinic immediately. These cases usually had severe retinal changes picked up by the JPA or staff nurse inspecting the photographs. They are then sent to a doctor in the polyclinic for appropriate action. If the reading ophthalmologist detects cases that require urgent treatment, he or she will phone the clinic where the photographs were taken and alert the staff nurse to recall the patient.

From June 1991 to June 1992, 20.7% were referred to the specialist eye clinics which included all the restructured and government hospitals which have eye clinics. From July 1992 to June 1993, 22.8% were referred despite a reduction in sight threatening retinopathy. Referrals does not just reflect diabetic retinopathy. Patients were also referred for other ocular conditions like cataracts, other degenerative retinal conditions and glaucoma.

DISCUSSION

The non-mydriatic retinal camera screening programme has shown that it has the advantages of accessibility, speed and

convenience. The spinoffs can be surmised. Primary health care doctors and general practitioners have an increased awareness of diabetic retinopathy and its implications. Patients by seeing their own retinal photos become aware of the damage diabetes has on their eyes. Seeing is believing; many doctors are seeing their patients' retinopathy and many patients are seeing their own retinopathy.

Photocoagulation reduces blindness rates in mild to moderate nonproliferative diabetic retinopathy and macular oedema, with deterioration after 3 years occurring in 24% of untreated eyes compared to 12% of treated eyes. In high risk proliferative retinopathy, only 15% of treated eyes became blind over a 5-year period compared to 50% in untreated controls[4]. As more diabetics are detected at an earlier stage, the treatment of diabetic retinopathy with laser photocoagulation will increase in the near term. Although diabetics with non sight-threatening retinopathy may not need treatment with laser, an awareness of the presence of retinopathy may improve patient compliance if patients relate poor diabetic control with the prospect of loss of sight. This programme also portends research potential as a tremendous amount of data is caught into a patient database. Because diabetes is a growing problem in Singapore, the implications for diabetic blindness are obvious. It is known that diabetes is the most important cause of new blindness in developed countries[10]. A comparison over four decades of blindness registration in Singapore showed that retinal degeneration (of which diabetes is a known contributing factor) has leapfrogged to be the most important cause of blindness in Singapore from 5.1% in the 1950s to 13.5% in the 1960s to 31.5% in the 1970s and 47.5% in the 1980s[11]. With this programme in place, it may help stem the tide of irreversible blindness from diabetic retinopathy. Public health administrators need pragmatic solutions. It is our firm belief that diabetic retinal screening by non-mydriatic retinal photography has proven itself to be a powerful weapon in a multipronged strategy to detect and prevent blindness from sight-threatening retinopathy.

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