Diabetic Retinopathy: Clinical Findings and Management

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Diabetes Mellitus

Diabetes mellitus is a metabolic abnormality in which there is a failure to utilise glucose and hence a state of hyperglycaemia can occur. If hyperglycaemia continues uncontrolled over time, it will lead to significant and widespread pathological changes, including involvement of the retina, brain and kidney.

In industrialised countries, approximately 1% of the population is diabetic, and at least another 1% are undiagnosed diabetics. Insulin dependent diabetes (IDDM), accounts for approximately 10–15% of cases, the remainder being maturity onset or non-insulin dependent diabetics (NIDDM). Diabetes mellitus is an international public health problem with estimated prevalences ranging from 2.0% to 11.7% in studied populations across the world.[1]

Prevalence of Diabetic Retinopathy

Diabetic retinopathy is increasingly becoming a major cause of blindness throughout the world in the age group of 20–60 years.[2,3,4] Loss of productivity and quality of life for the patient with diabetic retinopathy will lead to additional socio-economic burdens on the community.

Diabetic retinopathy is the cause of blindness in approximately 2.5 million of the estimated 50 million blind people in the world. However, diabetic retinopathy, as a cause of blindness, is less common in India according to population-based studies.[5,6] A recent study of diabetic patients in Pakistan indicated that cataract and uncorrected refractive error were more common causes of visual impairment than retinopathy.[7]

The VISION 2020 protocol projects diabetic retinopathy and the glaucomas as the 'emerging' causes of blindness in developing countries.

Epidemiological Studies in Diabetic Retinopathy

Epidemiological studies such as the Wisconsin Epidemiological Study on Diabetic Retinopathy,[8] the Diabetic Retinopathy Study (DRS),[9,10,11] the Early Treatment of Diabetic Retinopathy Study (ETDRS),[12,13,14,15,16,17] the Diabetes Control and Complications Trial (DCCT),[18] the Diabetic Retinopathy Vitrectomy Study (DRVS), [19,20] and the UK Prospective Diabetic Survey [21] have established the various risk factors and provided guidelines for the management of diabetic retinopathy.

General Risk Factors for Diabetic Retinopathy

1. ***Type of Diabetes and its Duration***. Tables 1 and 2 show the relationships between the type, duration of diabetes mellitus and retinopathy.
2. ***Control of Diabetes Mellitus***. The Diabetes Control and Complications Trial (DCCT)[18] has shown that in Type 1 insulin dependent diabetes mellitus (IDDM), good control of metabolic status will reduce the risk of progression of diabetic retinopathy and delays the onset of retinopathy in patients who do not have retinal changes at the time of presentation. The United Kingdom Prospective Diabetes Study (UKPDS)[21] has confirmed that good glycaemic control in Type 2 non-insulin dependent diabetes mellitus is also beneficial and delays the onset of retinopathy.
3. ***Hypertension***. Reports have indicated that high diastolic blood pressure in young individuals[8] and higher systolic blood pressures in older individuals[21] can worsen the retinopathy.
4. ***Pregnancy*** in women can be associated with worsening of the retinopathy.
5. ***Hyperlipidaemia***. Some studies have indicated that high levels of serum cholesterol and/or triglycerides are significant risk factors for retinopathy. However, it is yet to be clearly proved that therapy to reduce serum lipids affects any retinopathy. Cigarette smoking may or may not be an additional risk factor as its effect on cardiovascular disease is well documented.
6. ***Age***. In younger onset diabetes, diabetic retinopathy is uncommon before the age of 13 years. The onset of puberty may influence retinopathy – although the duration of diabetes is a significant factor. In those with older onset diabetes there is an increased frequency of retinopathy in those younger than 50 years.
7. ***Ethnicity***. The variety of study designs make comparisons difficult, but Afro-American blacks do seem to have more retinopathy than whites.

Table 1: Any Retinopathy
(Viswanath K, unpublished data)

	< 2 years	> 15 years
IDDM	2%	95%
NIDDM	10%	58%

Table 2: Proliferative Retinopathy
(Viswanath K, unpublished data)

	< 4 years	> 15 years
IDDM	0%	26%
NIDDM	3%	4%

Clinical Types of Diabetic Retinopathy

Clinical classification is as follows:

- ***Non-proliferative diabetic retinopathy***
- ***Proliferative diabetic retinopathy***.

Non-Proliferative Diabetic Retinopathy (NPDR)

The lesions in the retina at this stage are within the retina and include microaneurysms, small 'dot and blot' haemorrhages, 'splinter' haemorrhages, intraretinal microvascular abnormalities (IRMA) and 'cotton wool' spots.

The presence of these lesions in various degrees determines whether the NPDR is 'mild', 'moderate', 'severe' and 'very severe'.

1. *Mild Non-Proliferative Diabetic Retinopathy*

At least one microaneurysm, and also dot, blot or flame-shaped haemorrhages in all four fundus quadrants.

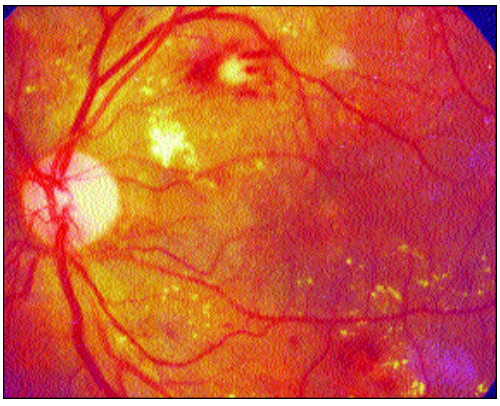

Fig. 1: Moderate non-proliferative diabetic retinopathy

Photo: K Viswanath

2. *Moderate Non-Proliferative Diabetic Retinopathy*

Intraretinal microaneurysms and dot and blot haemorrhages of greater severity, in one to three quadrants. Cotton wool spots, venous calibre changes including venous beading, and intraretinal microvascular abnormalities are present but mild.

3. *Severe Non-Proliferative Diabetic Retinopathy*

At least one of the following should be present: a) 'severe' haemorrhages and microaneurysms in all four quadrants of the fundus, b) venous beading, which is more marked in at least two quadrants, and c) intraretinal microvascular abnormalities, which are more severe in at least one quadrant.

4. *Very Severe Non-Proliferative Diabetic Retinopathy*

Two or more of the criteria for severe non-proliferative diabetic retinopathy, but without any proliferative diabetic retinopathy.

Diabetic Maculopathy

Diabetic retinopathy situated in and around the macula is described as ***diabetic maculopathy***, which can result in significant visual impairment. All these background diabetic retinal changes are due to pathology occurring at the microvascular level of the retina, including dilatation of the capillaries, destruction of the capillary walls and closure of the capillaries resulting in hypoxia and micro-infarcts.

The Early Treatment of Diabetic Retinopathy Study (ETDRS) classified patients who were given macular focal laser therapy, based on whether 'clinically significant macular oedema' was present or not.[12,13,15] This was classified as:

- Retinal thickening at or within 500µ (one third of the diameter of the optic disc) at the centre of the macula
- Hard exudates at or within 500µ of the centre of the macula, if there is thickening of the adjacent retina
- An area of retinal thickening greater than one optic disc area in size, at least a part of which is within one disc diameter of the centre of the macula.

The following photographs show non-proliferative and macular diabetic retinopathy.

1. Moderate non-proliferative diabetic retinopathy (Figure 1).
2. Diabetic maculopathy (Figure 2).

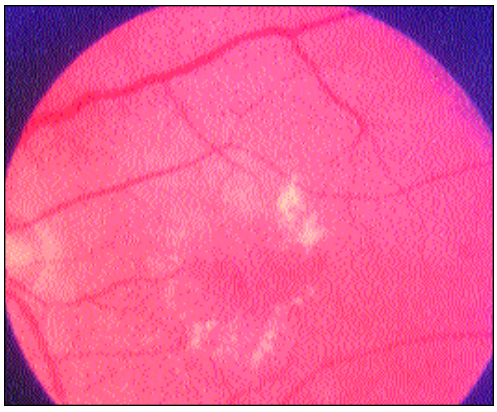

Fig. 2: Diabetic maculopathy

Photo: K Viswanath

Proliferative Diabetic Retinopathy (PDR)

Micro-vascular pathology with capillary closure in the retina leads to hypoxia of tissue. The hypoxia leads to release of vaso-proliferative factors which stimulate new blood vessel formation to provide better oxygenation of retinal tissue. These new vessels growing on the retina are called neovascularisation elsewhere (NVE) and those on the optic disc are called neovascularisation of the disc (NVD). These new vessels can bleed and produce haemorrhage into the vitreous.

The following photographs show examples of proliferative diabetic retinopathy (PDR).

1. PDR with NVE (Figure 3).
2. PDR with NVD (Figure 4).

Advanced Proliferative Diabetic Retinopathy

The unchecked progression of proliferative diabetic retinopathy can lead ultimately to tractional retinal detachment, which may or may not involve the macula. Vitreous haemorrhage may require B-scan ultrasonography to determine if a tractional or rhegmatogenous (retinal break or hole) retinal detachment is present. Neovascularisation of the anterior segment of the eye may cause intractable painful blindness due to neovascular glaucoma.

Screening for Diabetic Retinopathy

Diabetic retinopathy does not reduce vision in its early stages, when treatment is most effective. Preventing blindness from retinopathy relies on early detection of asymptomatic disease by fundus examination. The fundus may be examined by ophthalmoscopy, using a slit lamp and either a contact lens or a 78D lens, or by retinal photography, which may use conventional film or a digital camera. It has been shown that fundus photography is the most accurate means of screening for retinopathy. The photos allow an ophthalmologist to examine a large number of eyes very quickly. Digital fundus photography is expensive initially, but has very low running costs as it does not require film or developing the pictures. The images are available instantly. The quality of digital photos is not as good as conventional film,

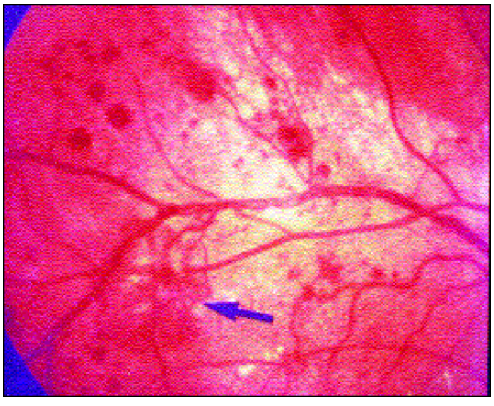

Fig. 3: Proliferative diabetic retinopathy with neovascularisation elsewhere

Photo: K Viswanath

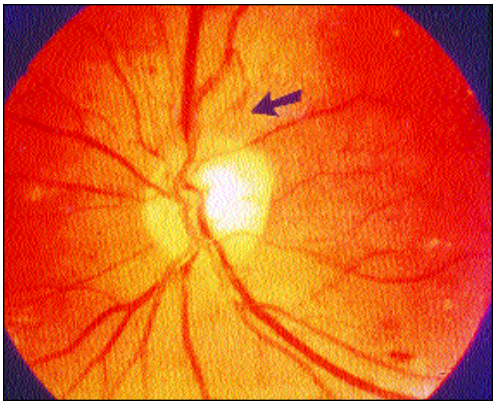

Fig. 4: Proliferative diabetic retinopathy with neovascularisation on the disc

Photo: K Viswanath

however, they are quite adequate for retinopathy screening.

In most developing countries there are too few ophthalmologists for every diabetic to be examined annually by an ophthalmologist. If retinal photography is not possible, then the fundus may be examined by the diabetic physician, an optometrist, or an ophthalmic assistant.

Screening for diabetic retinopathy is only effective if it achieves high coverage (at least 80% of known diabetics). It is essential that the screening process should be made as convenient as possible for diabetic patients. It should also be free.

Insulin-dependent/juvenile-onset diabetes

- Dilated fundus examination every year beginning 5 years after diagnosis, from puberty onwards
- Examinations more frequently once diabetic retinopathy is diagnosed.

Non insulin-dependent/maturity-onset diabetes

- Dilated fundus examination every year once diabetes diagnosed
- Examination more frequently once diabetic retinopathy diagnosed.

Diabetics are at significantly increased risk of cataract. All diabetics should have an annual measurement of visual acuity, and those with vision of less than 6/18 in either eye should have a full eye examination, as they may have cataract, refractive error, or glaucoma.

Treatment

Diabetic Control

As previously mentioned, good glycaemic control significantly reduces the risk of diabetic retinopathy developing and subsequently progressing. The importance of good control should be emphasised.

Laser Photocoagulation

The advent of laser photocoagulation of the retina has dramatically changed the management of diabetic retinopathy. The photocoagulation of non-proliferative diabetic retinopathy with clinically significant macular oedema is called macular photocoagulation, and widespread photocoagulation for proliferative diabetic retinopathy is called pan-retinal photocoagulation.

Macular Photocoagulation

Photocoagulation for diffuse leakage around the macula may be applied in a 'grid' fashion to prevent leakage – grid macular photocoagulation. Diffuse or focal leakage can be identified by fundus fluorescein angiography (FFA). FFA is done with black and white retinal photography using the contrast dye, sodium fluorescein, injected into the blood.

If 'clinically significant macular oedema' is present this may include:

- Focal leaks greater than 500µ from the centre of the macula, causing retinal thickening or hard exudates
- Focal leaks 300µ–500µ from the centre of the fovea, without significant damage to the perifoveal capillary network
- Areas of diffuse leakage on fluorescein angiography within the macular area
- Avascular areas within the macular area.

Pan-retinal Photocoagulation (PRPC)

Photocoagulating the posterior 45°–60° of the retina, away from the vascular arcades of the macula, with graded burns – to reduce the oxygen demand of the hypoxic retina in diabetic retinopathy – converts the hypoxic zones of the retina into anoxic zones, thereby reducing the release of vasoproliferative factors (Figure 5). PRPC, therefore, prevents new vessels appearing and can result in the regression of already existing new vessels on the retina or optic disc.

PRPC is indicated for the following clinical findings:

- Proliferative retinopathy
- New vessels of the iris.

Follow-up Management

Patients with diabetic retinopathy, whether treated or untreated, need periodic follow-up. Patients with diabetic maculopathy should be reviewed 3 to 4 months after treatment to check if the macular oedema has subsided. Patients who receive PRPC should be reviewed in 3 months to check for the regression or closure of new vessels and for the presence of any new vessels.

Surgery in Diabetic Retinopathy

Non-resolving vitreous haemorrhages and tractional retinal detachment, due to fibrovascular proliferation involving the macular region, require surgical procedures such as vitrectomy, pealing of epi-retinal membranes, endo-laser photocoagulation during surgery and vitreous replacement with silicone oil or perfluorocarbons.

Vitrectomy

Vitrectomy is indicated for vitreous haemorrhage – performed early for insulin dependent diabetics and after six months in non-insulin dependent diabetics if the haemorrhage does not clear.

Prevention of Blindness due to Diabetic Retinopathy

Prevention of blindness due to diabetic retinopathy requires information on the prevalence of diabetic retinopathy in the general population, identifying the high risk groups amongst diabetics, using cost effective screening methods such as ophthalmoscopy or fundus photography. Treatment facility centres require photocoagulators. Continuing medical education for diabetic care physicians, training ophthalmologists in photocoagulation and health education amongst diabetic patients should be established. It should be kept in mind that diabetic patients in certain populations may have visual impairment or blindness due to other causes, such as refractive error or cataract.

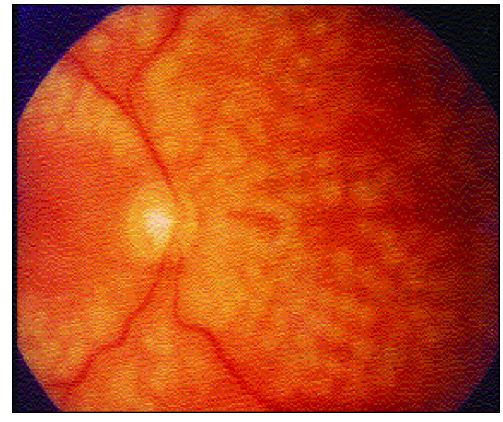

Fig. 5: Laser pan-retinal photocoagulation
Photo: K Viswanath

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Letters

Monitoring Cataract Surgical Outcomes
Moses C Chirambo (J Comm Eye Health 2002; 15: 58–59)

Dear Editor

Dr Chirambo paints a realistic picture of African cataract surgery where the result of the average cataract operation is not reaching the WHO recommended visual outcome.

Suppose I am a cataract surgeon working in an isolated hospital. Suppose I have the intellectual honesty and humility to begin the process of auditing my results. Suppose I find that 50% or more of my post-operative cataract patients fail to attain 6/18 or better vision. Who will help me to improve?

Suppose my surgical skills need to be updated. Suppose my selection of patients needs to be bettered. Where do I turn for help? Improvement is not going to happen simply by doing an audit. lf my results are mediocre then I need a non-threatening helping hand. But from where and from whom?

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Monitoring Cataract Surgical Outcomes
Hans Limburg (J Comm Eye Health 2002; 15: 56–57)
Monitoring Cataract Surgical Outcomes: Computerised Systems
David Yorston (J Comm Eye Health 2002; 15: 51–53)

Dear Editor

I read with interest the articles by Hans Limburg and David Yorston. Both mention using software to help with monitoring and the production of reports. David Yorston goes on to say '. . . the design of the database and the reports do need input from someone with the necessary expertise.' This expertise was obviously available at Kikuyu (Kenya) but will not necessarily be available to everyone.

I would therefore like to suggest that, if possible, the relevant files are made available to others who perhaps already have the hardware and software necessary, but lack the technical expertise to adapt the software for this purpose. This would also have the advantage that information could be readily shared between Eye Units and that, at a National, or Regional level, reports could be easily produced. Perhaps one means of disseminating these files would be by making them available to download from the JCEH website. In the future, perhaps other resources (power-point presentations, photographs from the teaching slide sets, leaflets, etc.) might be made avail-able in this way. This would help to avoid already hard pressed personnel 're-inventing the wheel' on a regular basis.

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