

# Diabetes

## don't forget the eyes

**Most people with diabetes eventually get some retinopathy. Early detection through regular dilated-pupil ophthalmoscopy or colour fundus photography allows timely laser treatment, which can prevent severe visual loss in over 90% of those at risk. Despite this outstanding medical benefit, only half our diabetic population are enrolled in a regular, effective screening program.**

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Diabetes affects about a million Australians and many are undiagnosed. Up to one-third of people with diabetes have some evidence of diabetic retinopathy at any time. Almost all eventually develop some evidence of this complication. Many people with type 2 diabetes are not under regular medical care, and loss of vision often occurs late in the progression of diabetic retinopathy.

Because diabetic retinopathy is common and has an effective treatment with laser, regular screening by dilated-pupil ophthalmoscopy, and preferably colour fundus photography, is essential.

### What is diabetic retinopathy?

Defined as the presence of typical retinal micro-vascular lesions in an individual with diabetes, nonproliferative or background retinopathy (NPDR) shows microaneurysms, dot and blot haemorrhages, hard exudates, cotton wool retinal infarcts and irregular dilated small vessels.

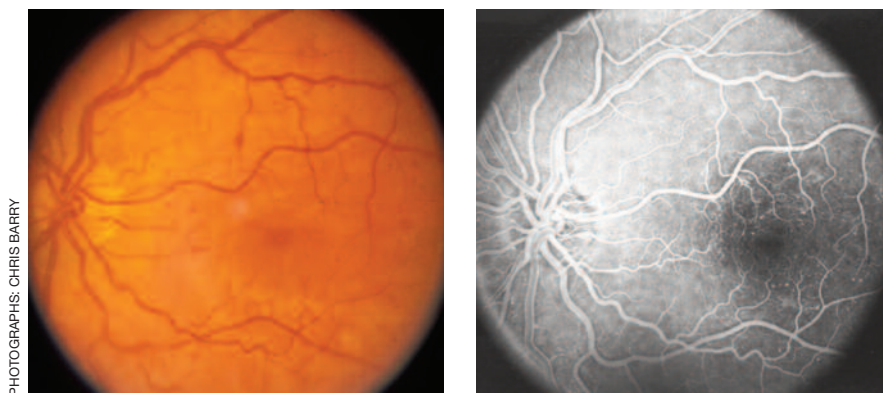
Blood glucose levels above the narrow physiological range over several years cause a variety of biochemical changes inside the delicate endothelial cells of retinal capillaries, and the result is leakage and slow capillary cell death. The resulting retinal ischaemia upregulates vascular endothelial growth factor. New capillary growth leads to proliferative diabetic retinopathy (PDR), which is characterised by new retinal vessels, fibrous tissue, preretinal or vitreous haemorrhage and traction retinal detachment.

### Which diabetic patients are at special risk?

In type 1 diabetes (insulin-dependent diabetes), which accounts for less than 10% of diabetes cases, the duration of diabetes is the major risk factor for retinopathy. The precision of control of blood glucose over many years helps determine the rate and severity of the retinopathy and

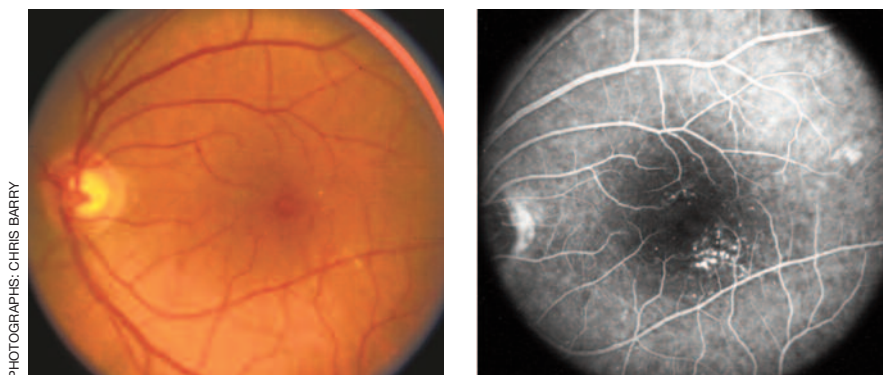
#### IN SUMMARY

- Almost all people with diabetes eventually develop some evidence of diabetic retinopathy.
- Regular screening is essential because diabetic retinopathy is common and has an effective treatment with laser photocoagulation.
- Make sure each of your diabetic patients has two normal eyes, by formal screening at the time of diagnosis and every one to two years thereafter.
- Tight control of blood glucose and glycosylated haemoglobin levels over many years can greatly decrease the risk of eye problems or their progression to visual loss.



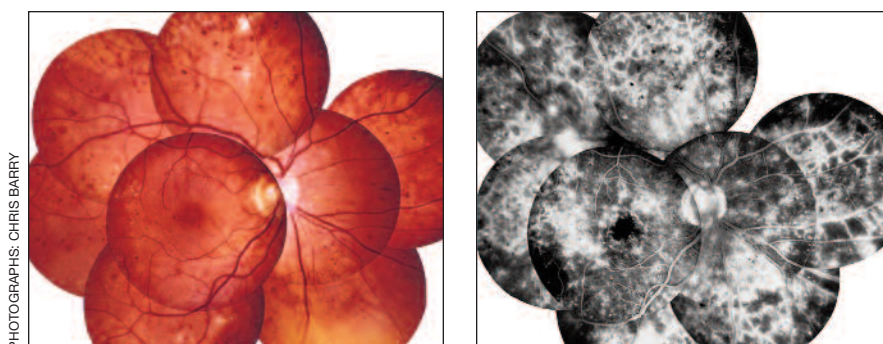
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Figures 1a and b. Early background diabetic retinopathy. a (left). Colour fundus photograph suitable for screening for retinopathy. b (right). Fluorescein angiography shows microaneurysms to be more prevalent than what is visible by ophthalmoscopy or colour photos. Vision is not yet threatened in this eye.



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Figures 2a and b. Early vision-threatening diabetic maculopathy. a (left). Colour photograph. b (right). Fluorescein angiography shows focal leaks threatening the central vision.



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Figures 3a and b. Advanced background diabetic retinopathy. a (left). Colour photography shows dot and blot haemorrhage, cotton wool spots and cloudy retinal thickening. Visual acuity is affected by macular swelling or ischaemia. b (right). Fluorescein angiography highlights intraretinal microvascular dilatation, leakage and capillary nonperfusion. Multiple scattered laser applications to the posterior pole and periphery are indicated as well as careful follow up to ensure the retinopathy has dried out.

the severity of progression. After 20 years with the disease, 90% of patients have some signs of the complication.

Type 2 (mature-onset) diabetes accounts for more than 90% of diabetes cases. Owing to widespread obesity, reluctance to exercise and an overall ageing of the general population, type 2 diabetes is rapidly increasing in the community. One in six cases of type 2 diabetes have detectable signs of retinopathy by the time they are discovered. The duration and degree of toxic levels of blood glucose influence the clinical severity, but there are a number of superimposed medical factors that may accelerate or be associated with visual loss. These include arteriosclerosis, hypertension (often associated with renal involvement) and blood lipid abnormalities. Local ocular stress may also decompensate mild diabetic retinopathy in the case of cataract surgery or uveitis.

At any one time, expect up to one-third of your diabetic patients to have some evidence of retinopathy and 10% to require laser treatment straight away. Special additional risks occur during pregnancy and in patients with chronic renal failure.

## Principles of management

Our first obligation is to find undetected and poorly controlled diabetes. The background prevalence of 2 to 7% depends on the age sampled and whether random fasting or two-hour post glucose load testing is carried out. In Aboriginal people and those who are overweight, the rate of diabetes can rise to almost 20%. While retinopathy will be present in up to one-third of diabetic patients, the rate of development of new retinal changes after a normal screening result is up to 10% per year. Therefore, make sure each of your diabetic patients has two normal eyes by formal screening at the time of diagnosis and every one to two years thereafter.

The onset of retinopathy and its progression are favourably modified by intervention. The combination of diet, regular exercise, weight reduction and

hyperglycaemic medication aims to bring blood glucose and glycosylated haemoglobin levels as close to the physiological range as possible. Measures to control hypertension, cholesterol and triglyceride levels, as well as stopping smoking, are also likely to help. People with diabetes are more prone than the general population to macrovascular eye disease such as retinal artery and vein occlusions and ischaemic optic neuropathy.

### Screening for diabetic retinopathy

Direct ophthalmoscopy can be difficult in diabetic patients. Older diabetic patients have small pupils and lens opacities. We need to dilate the pupils with tropicamide 0.5% (Minims Tropicamide, Mydracil) and dim the lights to detect tiny microaneurysms, hard exudates, cotton wool spots or retinal oedema. Studies have shown that even expert ophthalmoscopists under trial conditions will miss a significant proportion of diabetic lesions – and ophthalmologists and optometrists have the advantage of slit lamps and indirect and contact lens systems that greatly improve the view. The best solution is colour fundus photography (Figure 1), which is increasingly being made available not only through eye specialists but also in diabetic clinics and regional Aboriginal health services.

Recent Victorian studies have shown that only half the known diabetic population is presently having regular eye

examinations and that one-third have never had this service despite the high prevalence of retinopathy and the very effective available treatment if vision is threatened (Figures 2 and 3).

An action plan for screening diabetic retinopathy and a handout for patients can be found on this page and page 36.

### Ophthalmic treatment of diabetic retinopathy

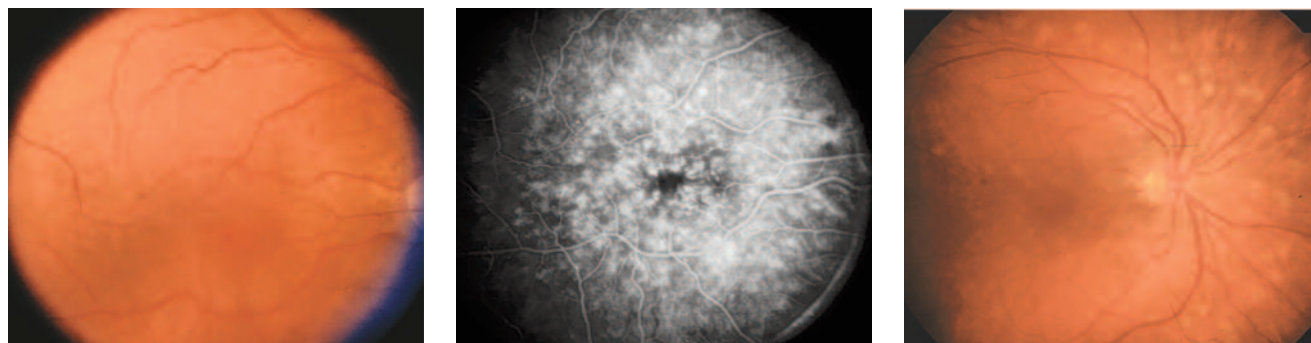
Laser photocoagulation is the application of hundreds of micro-burns to the retina with green laser light focused through a slit lamp. The procedure is slightly painful, often blurs the vision for a day or

two, and may need to be repeated on several occasions. Extensive controlled trials have confirmed its effectiveness in substantially reducing visual loss, both from bleeding in proliferative diabetic retinopathy and from clinically significant macular oedema in background retinopathy.

Not all patients with retinopathy require laser treatment. Many with minimal signs, no macular involvement and no new vessel growth can be observed for many years, particularly if their blood glucose levels are well controlled. Fluorescein angiography helps define the extent of retinopathy and a plan for laser treatment (Figure 4).

### Action plan for diabetic retinopathy screening

- Identify all patients with hyperglycaemia.
- Assess risk factors for diabetic retinopathy, including duration of diabetes, degree of control of blood glucose, blood pressure, lipid levels and associated complications (such as macrovascular disease of the heart, brain and legs, peripheral and autonomic neuropathies and renal disease).
- Using dilated-pupil ophthalmoscopy and preferably colour fundus photography, make sure the patient has two good eyes with no retinopathy.
- Refer all patients with any retinopathy for further ophthalmological assessment and possible laser treatment.
- In all patients with glucose intolerance, re-screen for retinopathy every one to two years depending on the predictive risk factors. Note that good visual acuity in each eye is no reassurance that potentially blinding retinopathy is absent.
- Refer any patient who has diminished vision in either eye. If the diminished vision is sudden, think of vitreous haemorrhage or ischaemic optic neuropathy. If it is gradual, think of cataract, diabetic maculopathy or chronic glaucoma.



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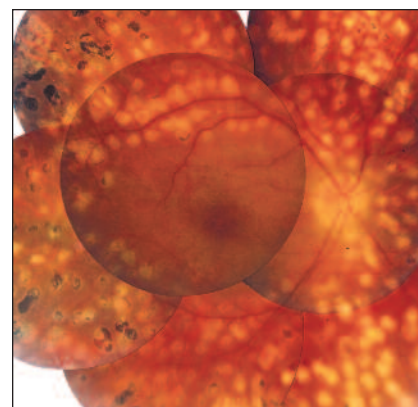
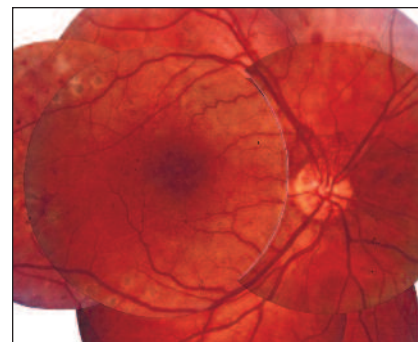
Figures 4a to c. Diabetic maculopathy requiring laser treatment. a (left). Colour photograph. b (centre). Fluorescein angiography showing macular oedema. c (right). A dry macula after laser treatment, showing multiple individual laser scars.



## Diabetic retinopathy: what can be done to prevent it or treat it

- If you have diabetes, you are at risk of developing diabetic retinopathy, an eye disease in which the blood vessels of the retina are damaged. Diabetic retinopathy can result in loss of vision if it is left untreated.
- It is important to keep to your blood glucose targets. Tight control of your blood glucose and glycosylated haemoglobin levels over many years can greatly decrease the risk of eye problems or their progression to visual loss. A high blood glucose over a long period of time can affect the tiny blood vessels in the retina and cause leakage and blurred vision.
- A careful check by skilled examination of your retina (with an ophthalmoscope or by colour photography) should be carried out at the time of diagnosis of diabetes and every one to two years for the rest of your life.
- Minor signs of diabetic retinopathy develop in most people over a long course of diabetes, but after assessment only a minority (10%) of people require laser treatment. Laser treatment for vision-threatening diabetic retinopathy is carried out after the eyes have been assessed by fluorescein angiography, which shows up the leaking areas in the retina.
- Laser treatment is very effective in preventing severe visual loss, but for it to be most effective it needs to be applied before vision is substantially lost.
- Laser treatment is still indicated after there has been substantial visual loss in an eye, but in most cases the vision will stay at the level it was before treatment.
- A small number of patients with diabetic retinopathy and bleeding require surgery to remove the blood-filled vitreous gel and scar tissue from the retinal surface.
- Remind your doctor to arrange the special eye examinations that detect early diabetic retinopathy.

This patient handout was prepared by Professor Ian Constable.

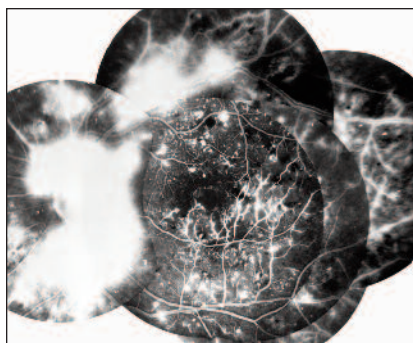
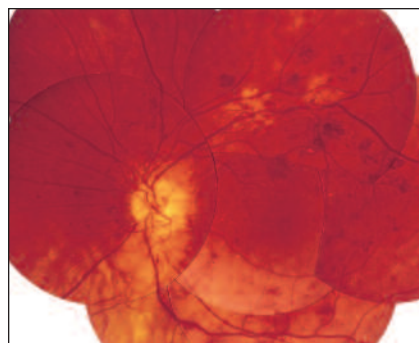


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Figures 6a and b. a (top). Proliferative diabetic retinopathy with raised new vessels at the optic disc. b (bottom). Regression of neo-vascularisation following panretinal photocoagulation of the periphery. Totally regressed proliferative diabetic retinopathy rarely reactivates and the therapeutic response is long term once sufficient laser is applied.

laser treatment. Living remote from care, inability for regular follow up, inability to optimise blood glucose, lipid or hypertensive control, renal failure and other macrovascular complications (including cardiac, cerebral and peripheral vascular ischaemia) would all prompt earlier laser intervention for retinopathy.

The benefits of early laser photocoagulation (Figure 6) are balanced against the modest but significant side effects, which include loss of a small amount of visual acuity and contrast, impaired light and dark adaption and, in patients requiring heavy recurrent treatment, loss of peripheral visual field.



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Figures 5a and b. Proliferative diabetic retinopathy, with new vessels on the optic discs (along with temporal vessels) and in the mid periphery. a (left). Colour photograph. b (right). Fluorescein angiography shows profuse leakage from the new vessels at all points, with surrounding areas of capillary nonperfusion signifying widespread retinal ischaemia.

Laser is indicated when there is macular oedema, hard exudate threatening the macula, adjacent retinal thickening, extensive intraretinal haemorrhages or early new vessel formation (Figure 5).

The general ocular health and patient profile are also taken into account. Thus, progressive cataract, ocular inflammation and progression of retinopathy in the other eye would all prompt earlier

### Follow up after laser treatment

The extent of laser treatment required is determined by regular follow up assessment. A significant proportion of older patients have slowly progressive chronic ischaemia of the retina and develop new lesions despite adequate previous laser treatment. The therapeutic endpoint is when no new lesions develop; this often requires the application of supplemental laser treatment on three or more occasions over two years. Once regression of new vessels in proliferative diabetic retinopathy is complete and new macular lesions stop occurring, follow up need be only every one to two years.

### Treatment of advanced diabetic retinal disease

Early vitrectomy with removal of tractional membranes is indicated once proliferative retinopathy progresses to fibrovascular scar tissue and retinal traction or dense vitreous haemorrhage that does not clear rapidly (Figure 7). Vitreoretinal surgery for advanced diabetic eye disease is very effective, particularly if some prior photocoagulation has been applied. Failed surgery or neglected proliferative diabetic retinopathy eventually results in total blindness with rigid

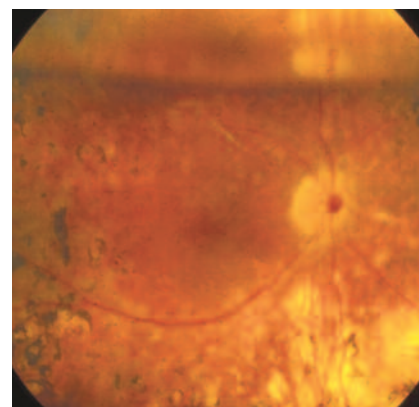
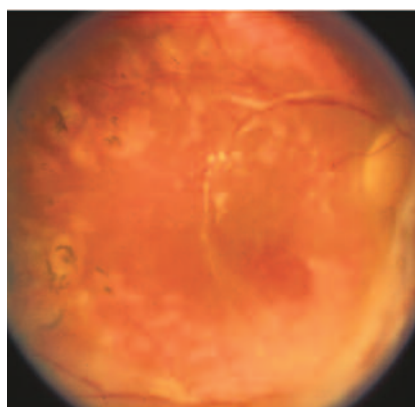
retinal detachment, neovascularisation of the iris, chronic internal ocular bleeding, secondary glaucoma and, in some cases, shrinkage of the eyeball.

### Diabetic retinopathy in rural and indigenous populations

Aboriginal people have an earlier onset, higher prevalence rate and more severe progression of diabetic retinopathy than the rest of the population. With the added effects of remoteness and less efficient access to medical services, high

carbohydrate diet, lack of exercise, obesity and other health problems, the rates of diabetic retinopathy and visual loss can be very high. The management of diabetic retinopathy in these communities is outlined in the box on this page.

The involvement of Aboriginal health workers in screening with colour fundus photography and the development of small portable lasers now provide the opportunity for all people to be screened and hopefully for many more to be treated early with laser photocoagulation.



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Figures 7a and b. a (left). Advanced proliferative diabetic retinopathy with fibrovascular scar tissue and traction retinal detachment. b (right). Appearance after successful vitreoretinal surgery and panretinal laser photocoagulation. This patient lost one line of vision and developed difficulties with light–dark adaption but retained the ability to read and drive a motor vehicle.

### Managing diabetic retinopathy in rural and indigenous communities

- Spot blood glucose tests help diagnose diabetes in most people; however, a fasting blood glucose uncovers a lot more cases. People diagnosed with diabetes should have fundus examination and photography through a local diabetes clinic, optometrist or visiting ophthalmologist as available.
- People with detectable diabetic retinopathy require an ophthalmic assessment and treatment by a visiting ophthalmologist with a portable laser or, failing that, referral to a larger centre for possible laser photocoagulation.
- The presence of any diabetic retinopathy should intensify an effort to assess renal function as well as cardiovascular risk factors, including hypertension and blood lipids.
- Weight reduction, exercise and a lower carbohydrate diet are keys to improving blood glucose control.
- Education of patients about the importance of controlling blood glucose and the associated risk factors should be arranged using all available resources.

### Useful websites for further information

#### Diabetes Australia

[www.diabetesaustralia.com.au](http://www.diabetesaustralia.com.au)

#### Vision 2020

[www.v2020australia.org](http://www.v2020australia.org)

#### National Health & Medical Research Council

[www.nhmrc.gov.au/publications/pdfcover/cp54covr.htm](http://www.nhmrc.gov.au/publications/pdfcover/cp54covr.htm) (providing a pdf of the publication 'Diabetes and your eyes: a consumer guide for the management of diabetic retinopathy')

The effective treatment of blinding eye disease is a good incentive for patients to be involved in improved diabetic control. The use of good digital images and transmission of these to co-ordinating centres, as well as to rural doctors and other health workers by teleophthalmology, could eventually allow the status of all diabetic eyes to be recorded. Preliminary cost-benefit analysis suggests that this may be feasible.

### Other nonretinal diabetic eye disease

Cataract, chronic open-angle glaucoma and diabetic ischaemic optic neuropathy are additional entities that can cause blindness in the diabetic population. Cataract is twice as common in people with diabetes compared on an age-matched basis with the general population, and cataract in diabetes requires special care. Although cataract surgery is no more difficult in the diabetic population, the visual outcomes are far worse if any diabetic retinopathy is present. Patients with subtle background diabetic retinopathy and cataract may progress, after routine cataract surgery, to develop intractable macular oedema and profound loss of vision. Prior fluorescein angiography and treatment of macular lesions with laser increase the potential for good postoperative vision.

All diabetic patients over the age of 40 years should have a glaucoma check because their incidence of glaucoma is approximately twice that of the general population. This is probably due to changes in the circulation to the optic nerve. Ischaemic optic neuropathy is a cause of sudden visual loss and has a poor prognosis for sight.

### Conclusion

Diabetes and its complications are on the increase in all populations. Early detection of diabetic retinopathy and timely laser treatment rank highly among medical interventions in terms of cost effectiveness and quality of life. We need to increase our efforts to make sure, through regular dilated-pupil ophthalmoscopy or colour fundus photography, that all individuals in our diabetic population have two normal eyes. We can reduce the prevalence of retinopathy and its progression to blinding eye disease by attention to management of blood glucose and other risk factors.

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