Diabetes and the Eye – A Nurses Perspective

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What is Diabetes?

“A complex metabolic disorder characterised by chronic hyperglycaemia resulting from defects in insulin secretion or insulin action, or both”

First described in 1552 BC in the Ebers papyrus
Two Main Types

- **Type 1**
  - Autoimmune destruction of the $\beta$ cells of the Islets of Langerhans in the pancreas. This leads to an absolute insulin deficiency. Insulin treatment is therefore mandatory.
  - Previously known as IDDM or juvenile onset diabetes.
Two Main Types

- **Type 2**
  - Impaired insulin action (insulin resistance) and eventually, impaired insulin secretion as well
  - Usually treated with oral medication initially, then may move onto insulin
  - Formerly known as NIDDM or maturity onset diabetes
Diabetes and the Eye - Some History

- In the 1970’s and 1980’s diabetes was the leading cause of severe visual impairment

- People with diabetes were 25 times more likely to have a VA of 20/200 in their best eye due to
  - Haemorrhage
  - Tractional detachment of the macula due to proliferative diabetic retinopathy (PDR)
  - Macular oedema
  - Cataract
  - Glaucoma

Klein R & Klein BE Diabetes 2010;59(8):1853-1860
There was no definitive evidence that achieving good glycaemic control would actually result in less DR.

Also, technology was not of a standard to allow easy optimisation of control.

In the early 1970’s the efficacy of photocoagulation had not yet been demonstrated.

Vitrectomy was in its developmental stages.

Klein R & Klein BE Diabetes 2010;59(8):1853-1860
The Relationship Between Glycaemic Control and Retinopathy

- In 1978 Kelly M West wrote “The extent to which the level of hyperglycaemia determines the risk of retinopathy is not at all clear. This is the most important issue at hand and deserves high priority in epidemiologic research”

It was the Wisconsin Epidemiologic Study of Diabetic Retinopathy (WESDR) cohort data that first demonstrated a relationship between glycaemic control and the risk of retinopathy.

Klein R et al JAMA 1988;260:2864-2871
DCCT and UKPDS

- It was then the DCCT and UKPDS that showed that improving glycaemic control substantially reduced the risk of developing retinopathy
  - 76% reduction in the progression of retinopathy in the primary prevention cohort of the DCCT
  - 54% reduction in the progression of DR in the secondary prevention cohort of the DCCT
  - 21% reduction in the progression of DR in the UKPDS
  - 29% reduction in the need for laser photocoagulation in the UKPDS

DCCT Research Group NEJM 1993;329(14):977-986
UKPDS 33 Lancet 1998;352:837-853
What Are the Other Risks??

- Poorly controlled diabetes leads to accelerated cardiovascular morbidity and mortality

- A combination of microvascular and macrovascular disease

Thom T et al Circulation 2006;113(6):e85-151
Data From 3.3M Danes

Vascular Complications Of Type 2 Diabetes At The Time Of Diagnosis

OK, so You Die – So What?

- Diabetes remains:
  - The most common cause of blindness in the developed world
Retinopathy and Duration of Diabetes

8784 people with type 1 diabetes

Retinopathy and Severity of Diabetes


HbA1c > 53 mmol/mol (7.0%)

HbA1c ≤ 53 mmol/mol (7.0%)

Duration of diabetes (years)

Patients without retinopathy (%)
Data from Wisconsin suggests that up to 70% of people with type 1 have retinopathy, and 40% of people with type 2.

Of those with type 1, up to 50% will have proliferative disease within 20 years of diagnosis.

### Table 2: Multiple logistic regression analysis, any retinopathy

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>1.19</td>
<td>1.05–1.34</td>
<td>0.0057</td>
</tr>
<tr>
<td>Age at onset &lt;5 years</td>
<td>0.41</td>
<td>0.335–0.502</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>HbA&lt;sub&gt;1c&lt;/sub&gt; &gt;7.0%</td>
<td>2.23</td>
<td>1.93–2.57</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>(53 mmol/mol)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>Removed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hypertension</td>
<td>Removed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smoking</td>
<td>1.3</td>
<td>1.13–1.48</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

**Table 3** Multiple logistic regression analysis, severe retinopathy

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR</th>
<th>95% CI</th>
<th>p value&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male sex</td>
<td>1.25</td>
<td>1.06–1.148</td>
<td>0.0094</td>
</tr>
<tr>
<td>Age at onset &lt;5 years</td>
<td>0.66</td>
<td>0.51–0.86</td>
<td>0.015</td>
</tr>
<tr>
<td>HbA&lt;sub&gt;1c&lt;/sub&gt; &gt;7.0% (53 mmol/mol)</td>
<td>1.52</td>
<td>1.26–1.84</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Dyslipidaemia</td>
<td>1.58</td>
<td>1.31–1.90</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.70</td>
<td>1.34–2.16</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Achieving Good Glycaemic Control – the Effects of Insulin on the Eye

- Tight glycaemic control using insulin is unequivocally associated with a long-term decreased risk of the development and progression of diabetic retinopathy in patients with either type 1 or type 2 diabetes mellitus.

- If achieved early, this effect is maintained independently of glycaemic control.

- There is a legacy effect of glycaemic control.

Silva PS et al Nat Rev Endocrinol 2010;6(9):494-507
Other Preventative Strategies?

- The use of RAAS blockers (Euclid, Direct)
- Direct showed an NNT of 18 to prevent, and NNT of 21 to protect against progression
- Older agents such as enalapril and losartan also slow progression in type 1
- Lowering TG levels using fibrates also reduces the need for laser

Sjolie AK et al Lancet 2008;372(9647):1385-1393
Maure M NEJM 2009;361(1):40-51
Keech AC et al Lancet 2007;370(9600):1687-1697
What About ‘Early Worsening’?

- In the first 2 years following the initiation of intensive insulin therapy, diabetic retinopathy can transiently worsen.

- However, over the long term, intensive glycaemic control is associated with improved retinopathy and visual outcomes.

- Early worsening has been shown to be more common in patients with poorly controlled, long-standing diabetes mellitus with moderate or more advanced non-proliferative diabetic retinopathy.
Early Worsening

- Thus, this subgroup requires careful ophthalmologic monitoring before initiation of intensive treatment and for at least 6-12 months following initiation of intensive treatment, at a minimum of 3-monthly intervals
OK, So You Go Blind Before You Die

- It is the most common cause for non-traumatic lower limb amputations in the world – in the UK, 50% of these occur in the 4% of the population who have diabetes
OK, So You’re Blind and Limp

- Diabetes is the most common cause of end stage renal disease in the world
Nephropathy and Glycaemic Control

![Graph showing the relationship between rate per 100 patient-years and glycosylated hemoglobin percentage. The graph illustrates a positive correlation between glycosylated hemoglobin and microalbuminuria rate.](image)

DCCT Research Group NEJM 1993;329(14):977-986
You have a 2 – 3 fold increased risk of macro-vascular risk
  i.e. strokes and heart attacks
Glycaemic Control is Important

UKPDS Lancet 1998;352(9131):837-853

Reduction in risk per 1% reduction in $A_1C$
- Overall: 21%*
- Diabetes mortality: 21%*
- MI: 14%
- Stroke: 12%†
- Microvascular: 37%*
- Heart failure: 16%†
- Cataract extraction: 19%*
- Amputations or PVD death: 43%*

* $P < 0.0001$.
† $P < 0.05$. 

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Blind, Limp, on Dialysis and Someone Wiping your Bottom

It’s all preventable
Overview

- The National Screening Committee grading system

Grading and disease management in national screening for diabetic retinopathy in England and Wales


Grading Classification

<table>
<thead>
<tr>
<th>Grade (R)</th>
<th>Level</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinopathy</td>
<td>0</td>
<td>None</td>
</tr>
<tr>
<td>Level 1</td>
<td></td>
<td>Microaneurysm(s)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Retinal haemorrhage(s) ± any exudate</td>
</tr>
<tr>
<td>Level 2</td>
<td>Preproliferative</td>
<td>Venous beading</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Venous loop or reduplication</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Intraretinal microvascular abnormality (IRMA)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Multiple deep, round or blot haemorrhages</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(CWS—careful search for above features)</td>
</tr>
<tr>
<td>Level 3</td>
<td>Proliferative</td>
<td>New vessels on disc (NVD)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>New vessels elsewhere (NVE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preretinal or vitreous haemorrhage</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Preretinal fibrosis ± tractional retinal detachment</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade (M)</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maculopathy</td>
<td>Exudate within 1 disc diameter (DD) of the centre of the fovea</td>
</tr>
<tr>
<td></td>
<td>Circinate or group of exudates within the macula</td>
</tr>
<tr>
<td></td>
<td>Retinal thickening within 1 DD of the centre of the fovea (if stereo available)</td>
</tr>
<tr>
<td></td>
<td>Any microaneurysm or haemorrhage within 1 DD of the centre of the fovea only</td>
</tr>
<tr>
<td></td>
<td>if associated with a best VA of ≤ (if no stereo) 6/12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade (P)</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Photocoagulation</td>
<td>Focal/grid to macula</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Grade (U)</th>
<th>Feature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unclassifiable</td>
<td>Peripheral scatter</td>
</tr>
</tbody>
</table>
## Management of Each Grade

<table>
<thead>
<tr>
<th>Condition</th>
<th>Grade</th>
<th>Management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Retinopathy (R)</td>
<td>R0</td>
<td>Annual screening</td>
</tr>
<tr>
<td></td>
<td>R1</td>
<td>Annual screening</td>
</tr>
<tr>
<td></td>
<td>R2</td>
<td>Refer to hospital eye service</td>
</tr>
<tr>
<td></td>
<td>R3</td>
<td>Fast-track referral to hospital eye service</td>
</tr>
<tr>
<td>Maculopathy (M)</td>
<td>M1</td>
<td>Refer hospital eye service</td>
</tr>
<tr>
<td>Photocoagulation (P)</td>
<td>P1</td>
<td>New screenee→refer hospital eye service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Quiescent post treatment→annual screening</td>
</tr>
<tr>
<td>Other lesions (OL)</td>
<td></td>
<td>Refer to hospital eye service or inform primary physician</td>
</tr>
<tr>
<td>Ungradable/unobtainable (U)</td>
<td></td>
<td>Poor view but gradable on biomicroscopy→refer hospital eye service</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unscreenable→discharge, inform GP</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(option to recall for further photos if purely technical failure)</td>
</tr>
</tbody>
</table>
So What Can **YOU** Do?

- **Be active**
  - Ask if they take their medications every day
  - Ask if they experience any side effects
  - Ask if they have mentioned any of these things to their doctors
  - **TELL THEM TO STOP SMOKING**

- **Be their advocate**
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www.norfolkdiabetes.com