DIABETIC RETINOPATHY 2019
WHAT EVERY PROVIDER NEEDS TO KNOW ABOUT DIABETIC RETINAL EXAM

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Financial Disclosure: None
Learning Objectives

- Basic anatomy of the eye
- Recognize the importance of diabetic retinopathy as a public health problem
- Identify the risk factors for diabetic retinopathy
- Describe the stages of diabetic retinopathy
- Understand the role of risk factor control and annual dilated eye exams in the prevention of vision loss
What is the most common cause of vision loss among working age adults in the United States?

1. Glaucoma
2. Cataract
3. Diabetic Retinopathy
4. Retinal Detachment
The most common cause of moderate vision loss in diabetic retinopathy is:

1. Refractive Change
2. Cataract
3. Diabetic Macular Edema
4. Proliferative Diabetic Retinopathy
A patient with Type II diabetes should get their first dilated eye exam:

1. Only when the vision is affected
2. In 3-5 years after initial diagnosis of diabetes
3. At the time of diagnosis of diabetes
4. 1 year after the diagnosis of diabetes
Anatomy of the Eye

Human retina

macula
fovea
arteries
veins
optic nerve

Human retina
RETINA
Healthy Retina

Diabetic Retinopathy
Diabetes in the United States

- National Diabetes Statistics Report (2014) found that in 2012:
  - 29.1 million Americans (9.3% of the population) have diabetes
  - 8.1 million undiagnosed
  - 86 million Americans (27%) age 20 and older have prediabetes, up 7 million from 2010
- Total diagnosed + undiagnosed cases of diabetes in the U.S. projected to nearly triple by 2050
- Cost to the U.S. government - $500 million annually

Estimated age-adjusted prevalence of diagnosed diabetes by race/ethnicity and sex among adults aged ≥18 years, United States, 2013–2015

- AI/AN: Men - 14.9%, Women - 15.3%
- Asian: Men - 9.0%, Women - 7.3%
- Black, non-Hispanic: Men - 12.2%, Women - 13.2%
- Hispanic: Men - 12.6%, Women - 11.7%
- White, non-Hispanic: Men - 8.1%, Women - 6.8%
Age-adjusted Prevalence of Obesity and Diagnosed Diabetes Among US Adults

Obesity (BMI ≥30 kg/m²)

1994

Diabetes

1994

CDC’s Division of Diabetes Translation. United States Surveillance System available at http://www.cdc.gov/diabetes/data
“I think diabetes is affecting my eyesight. I have trouble seeing the consequences of my food choices.”
Diabetes Prevalence Among Adults, Age 20+: United States 2004-2010

CDC, County Level Data, 2010
Diabetic Retinopathy Epidemiology

- CDC study (https://www.cdc.gov/visionhealth/pdf/factsheet.pdf)

- One in 3 people over the age of 40 years with diabetes have diabetic retinopathy
- 4.2 million adults had Diabetic retinopathy
- 655,000 had vision-threatening diabetic retinopathy

- The more severe vision-threatening form is more common in Mexican Americans and African-Americans.

- Diabetic retinopathy (DR) is the leading cause of blindness in people of working age in industrialized countries.
Global Prevalence Diabetic Retinopathy

- Africa
- South-East Asia
- Western Pacific
- Developed countries

Risk factors for DR

- Male sex
- Higher A1C
- Longer duration of diabetes
- Insulin use
- Higher systolic blood pressure
- Barriers to care

http://jama.ama-assn.org/content/304/6/649.short?rss=1
Diabetic Retinopathy
Epidemiology

• The best predictor of diabetic retinopathy is the duration of the disease

• After 20 years of diabetes, nearly 99% of patients with type 1 diabetes and 60% with type 2 have some degree on diabetic retinopathy

• 33% of patients with diabetes have signs of diabetic retinopathy

• People with diabetes are 25 times more likely to become blind than the general population.
Prevalence of diabetic retinopathy after 20 years of diagnosis

![Bar chart showing prevalence of diabetic retinopathy in type 1 and type 2 diabetes. The chart indicates a higher prevalence in type 1 diabetes.]
Diabetic Retinopathy

Pathophysiology

• Elevated blood glucose results in physiologic changes that cause vascular endothelial damage.
  • Loss of pericytes
  • Basement membrane thickening

• Pathologic processes associated with diabetic retinopathy
  • Formation of microaneurysms
  • Closure of retinal capillaries and arterioles
  • Increased vascular permeability of retinal capillaries
  • Proliferation of new vessels and fibrous tissue
  • Contraction of vitreous and fibrous proliferation leading to tractional retinal detachment
Diabetic Retinopathy

- Risk Factors associated with progression of diabetic retinopathy:
  - Hypertension
  - Elevated triglycerides
  - Elevated lipids,
  - Gross proteinuria

- Patients with Proliferative Diabetic Retinopathy are at increased risk of myocardial infarction, stroke, diabetic nephropathy, amputation, and death

- NOTE: No ocular contraindications to aspirin when required for cardiovascular disease or other medical conditions.
Diabetic Retinopathy

Causes of vision loss

- Macular edema (thickening of central retina)
- Macular ischemia
- Macular/foveal hemorrhage
- Vitreous or preretinal hemorrhage
- Retinal traction and detachment
Diabetic retinopathy symptoms

Diabetic retinopathy is asymptomatic in early stages of the disease.
As the disease progresses symptoms may include:

- Blurred vision
- Floaters
- Fluctuating vision
- Distorted vision
- Dark areas in the vision
- Poor night vision
- Impaired color vision
- Partial or total loss of vision
4 Stages of Diabetic Retinopathy:

1. Mild Nonproliferative Retinopathy (NPDR)
2. Moderate Nonproliferative Retinopathy
3. Severe Nonproliferative Retinopathy
4. Proliferative Retinopathy (PDR)

Goal is to diagnose as early as possible!
### Risk of Progression from NPDR to PDR

<table>
<thead>
<tr>
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<th>1 year</th>
<th>5 yrs</th>
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<tbody>
<tr>
<td>Mild NPDR</td>
<td>5%</td>
<td>15%</td>
</tr>
<tr>
<td>Moderate NPDR</td>
<td>27%</td>
<td>33%</td>
</tr>
<tr>
<td>Severe NPDR</td>
<td>52%</td>
<td>60%</td>
</tr>
<tr>
<td>Very Severe NPDR</td>
<td>75%</td>
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</table>
No retinopathy
MILD NONPROLIFERATIVE DIABETIC RETINOPATHY

Characteristics

• Microaneurysms only
MILD NONPROLIFERATIVE DIABETIC RETINOPATHY

Microaneurysms
Moderate Nonproliferative Diabetic Retinopathy (NPDR)

Characteristics

More than just microaneurysms but less than severe NPDR
Moderate Nonproliferative Diabetic Retinopathy (NPDR)

- Microaneurysm
- Hard exudates
- Flamed shaped hemorrhage
Severe Nonproliferative Diabetic Retinopathy (NPDR)

Any of the following:

- More than 20 intraretinal hemorrhages in each of four quadrants
- Venous beading in two or more quadrants
- Prominent Intraretinal Microvascular Abnormalities (IRMA) in one or more quadrants
- **And** no signs of proliferative retinopathy
Severe Nonproliferative Diabetic Retinopathy (NPDR)

Venous beading
PROLIFERATIVE DIABETIC RETINOPATHY

Neovascularization
Diabetic macular edema

• Diabetic macular edema is the leading cause of legal blindness in diabetics.
• Diabetic macular edema can be present at any stage of the disease, but is more common in patients with proliferative diabetic retinopathy.
Imaging of macular edema with optical coherence tomography
Diabetic Macular Edema Prevalence

- Mild non-proliferative DR: 3
- Moderate to severe non-proliferative DR: 38
- Proliferative DR: 71

Meta analysis and review on the effect on bevacizumab on diabetic macular edema
Why is Diabetic macular edema so important?

• The macula is responsible for central vision.
• Diabetic macular edema may be asymptomatic at first. As the edema moves in to the fovea (the center of the macula) the patient will notice blurry central vision. The ability to read and recognize faces will be compromised.
Normal Vision

Vision with Diabetic Retinopathy
Macular Ischemia can lead to profound vision loss
Diabetic Retina Exam

• Slit-lamp examination (dilated eye exam)
• Optical Coherence tomography (OCT)
• Fluorescein angiography

• New technology
  • OCT-angiography (non-invasive angiography)

• AI/Deep learning system
Association Between Vessel Density and Visual Acuity in Patients With Diabetic Retinopathy and Poorly Controlled Type 1 Diabetes.
Bénédicte Dupas, MD; Wilfried Minvielle, MD; Sophie Bonnin, MD; Aude Couturier, MD; Ali Erginay, MD; Pascale Massin, MD, PhD; Alain Gaudric, MD; Ramin Tadayoni, MD, PhD


Figure 4. Optical Coherence Tomography in the Eyes of the Control Group and Patients With Diabetes

A Healthy eye, control group

B Eye with diabetic retinopathy and normal VA

C Eye with diabetic retinopathy and decreased VA

Normal visual acuity (VA) represents 0 logMAR (Snellen equivalent, 20/20); decreased VA for the eye depicted represents 0.3 logMAR (Snellen equivalent, 20/40). Irregularities of the inner retinal layers are visible in all eyes with diabetic retinopathy; the stage is more advanced in the patient with the worst VA.

Figure 3. Vessel Densities in Eyes of Patients With Diabetes and Decreased Visual Acuity

A Superficial vascular plexus
B Deep capillary complex
C Intermediate capillary plexus
D Deep capillary plexus

A vessel rarefaction is seen in all plexuses (A-D), but the deep capillary plexus (D) is strongly damaged because capillary nonperfusion areas are detected far outside the foveal avascular zone.
JAMA 2017
71,896 images; 14,880 patients. DLS had
90.5% sensitivity and 91.6% specificity for detecting referable diabetic retinopathy;
100% sensitivity and 91.1% specificity for vision-threatening diabetic retinopathy;
96.4% sensitivity and 87.2% specificity for possible glaucoma;
93.2% sensitivity and 88.7% specificity for age-related macular degeneration, compared with professional graders.

Sensitivity – true positive rate (high sens = few false negatives)
Specificity – true negative rate  (high spec = few false positives)
DIABETIC RETINOPATHY TREATMENT

The best measure for prevention of loss of vision from diabetic retinopathy is strict glycemic control.
The Effect of Intensive Diabetes Treatment
On the Progression of Diabetic Retinopathy
In Insulin-Dependent Diabetes Mellitus

*The Diabetes Control and Complications Trial*

*The Diabetes Control and Complications Trial Research Group*

Intensive control reduced the risk of developing retinopathy by 76% and slowed progression of retinopathy by 54%; intensive control also reduced the risk of clinical neuropathy by 60% and albuminuria by 54%.

Arch Ophthalmol. 1995; 113:36-51
Primary prevention
- Strict glycemic control
- Blood pressure control

Secondary prevention
- Annual eye exams

Tertiary prevention
- Retinal Laser photocoagulation
- Anti-VEGF injections
- Vitrectomy
Treatment Options

ETDRS

1985

laser

DRCR.net Protocol B

2008

Intravitreal triamcinolone
Changing Treatment Paradigm for DME

- **2009**: DRCR Protocol I: Anti-VEGF, IVTA, Laser
- **2010**: FAME Study
- **2012**: RISE / RIDE: Ranibizumab wins FDA Approval
- **2013**: VIVID / VISTA: Aflibercept wins FDA Approval
- **2014**: MEAD Study
- **2015**: DRCR.net Protocol T: Anti-VEGF Head-to-Head

**Intravitreal Steroids**

Dexamethasone and flucinolone acetonide intravitreal implants win FDA approval

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Protocol T DRCR.Net  2 year results
Aflibercept, Bevacizumab, or Ranibizumab for Diabetic Macular Edema Two-Year Results from a Comparative Effectiveness Randomized Clinical Trial
Protocol T DRCR.Net
2 year results

Baseline VA: 20/50 or worse

Baseline VA: 20/32 to 20/40
1 month after antiVEGF treatment
28 y.o WM with blurry vision right eye for 6 months, left eye for 1 week
Diagnosed with DM 2 weeks ago
Vision 20/400 OD; 20/200 OS

Plan: PRP Left eye same day
Vitrectomy, membrane peel, laser, gas Right eye in 10 days
### Follow-up Guidelines

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<tr>
<th>Age of Onset</th>
<th>First Examination</th>
<th>Follow-up</th>
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<tr>
<td>0 to 30 years (Type 1)</td>
<td>Within 5 years</td>
<td>Yearly</td>
</tr>
<tr>
<td>31 years and older (Type 2)</td>
<td>Upon diagnosis</td>
<td>Yearly</td>
</tr>
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| Prior to pregnancy (Type 1 or 2)          | Prior to conception or early 1<sup>st</sup> trimester | No retinopathy to mild-moderate NPDR: 3-12 months  
Severe NPDR or worse: 1-3 months |

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<thead>
<tr>
<th>Severity of Retinopathy</th>
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<tbody>
<tr>
<td>Diabetes only</td>
<td>Yearly</td>
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<tr>
<td>Mild-moderate NPDR</td>
<td>Every 6 months</td>
</tr>
<tr>
<td>Severe NPDR</td>
<td>Early 3-4 months</td>
</tr>
<tr>
<td>PDR</td>
<td>Every 3 months</td>
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</table>
Diabetic Retinopathy is preventable through strict glycemic control and annual dilated eye exams by an ophthalmologist.
People with diabetes need to know...
Who can develop diabetic retinopathy?
How does diabetes damage your eyes?

- Damaged blood vessels
- A closer look
How can diabetic retinopathy cause vision loss?

Left untreated, diabetic retinopathy can cause vision loss.

Diabetic retinopathy can damage your eyes even before you see changes in your vision.
Who is at risk for diabetic retinopathy?

• All people with diabetes
  • Type 1
  • AND Type 2
• During pregnancy, diabetic retinopathy may be a problem for women with diabetes.

Between 40 to 45 percent of Americans diagnosed with diabetes have some stage of diabetic retinopathy.
Important!

• It is important to diagnose or catch diabetic retinopathy before symptoms occur!

• You may see great – and still have the early stages of diabetic retinopathy.

Key is to catch and manage the disease early in its stages to preserve vision.
Why is a dilated eye exam important?
What happens when you get a dilated eye exam?

**UNDILATED PUPIL**
- Retina
- Ray of light
- Portion of retina that can be seen through undilated pupil
- Optic nerve
- Pupil

**DILATED PUPIL**
- Retina
- Ray of light
- Portion of retina that can be seen through dilated pupil
- Optic nerve
- Pupil

Presented by: Mohan N. Iyer, M.D.
Risk factors Diabetic Retinopathy

Duration of diabetes is a major risk factor associated with the development of diabetic retinopathy.

The severity of hyperglycemia is the key alterable risk factor associated with the development of diabetic retinopathy.
Diabetic Retinopathy

- Diabetes is the leading cause of blindness in patients aged 20-64 years.

- Patients can have severe diabetic retinopathy and still be asymptomatic. Early detection and treatment can help prevent vision loss.

- Regular exams, treatment guidelines for medical and surgical management of diabetic eye disease are capable of reducing the risk of severe vision loss and blindness by 90%

- Treatment options for diabetic macular edema and proliferative diabetic retinopathy include laser photocoagulation, intravitreal injection of steroid or anti-VEGF agents, and vitrectomy surgery.
• What is the most common cause of vision loss among working age adults in the United States?

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• 2. Cataract
• 3. Diabetic Retinopathy
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Thank you!