Retinal Diseases

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Financial Disclosures
Overview

- Background Information
- Retinal Vascular Disease
- Age-Related Macular Degeneration
- Diabetic Retinopathy
- Questions from the Audience
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The eye can only perceive a small portion of the spectrum of electromagnetic waves.
External Features and Accessory Structures of the Eye
The Pupillary Muscles

- Pupillary dilator muscles (radial)
- Pupillary constrictor muscles (sphincter)

Dilators contract

Constrictors contract
The Sectional Anatomy of the Eye

- Fornix
- Eyelid
- Eyelash
- Limbus
- Optic nerve
- Lens
- Pupil
- Ocular conjunctiva
- Palpebral conjunctiva
- Fovea
- Ora serrata
- Anterior cavity
- Vascular tunic
- Iris
- Ciliary body
- Choroid
- Neural tunic (retina)
- Neural part
- Pigmented part
- Cornea
- Sclera
- Fibrous tunic
- Posterior cavity
The Circulation of Aqueous Humor
Eye Abnormalities

- **Glaucoma**
- **Cataract**

Aqueous humor continuously circulates from behind the iris into the anterior chamber. It exits the eye where the iris and the cornea meet. The fluid filters through the trabecular meshwork before passing into an open channel called Schlemm's canal.
Image Formation

(a) The closer the light source, the longer the focal distance

(b) The rounder the lens, the shorter the focal distance
Accommodation

It is the process of adjusting the shape of the lens so that the external image fall exactly on the retina
The Organization of the Retina
Rods and Cones

Old discs at tip are phagocytized by pigment epithelial cells

PIGMENT EPITHELIUM

Melanin granules

OUTER SEGMENT

Visual pigments in membrane discs

Discs

Connecting stalks

INNER SEGMENT

Location of major organelles and metabolic operations such as photopigment synthesis and ATP production

Mitochondria

Golgi apparatus

Nuclei

Cone

Rods

Synapses with bipolar cells

Bipolar cells

(a)

LIGHT

(b)

Rhodopsin molecule

Retinal

Opsin

Discs
Retinal structure

- Three cell layers:
  - outer layer: photoreceptors - rods and cones
  - middle layer: bipolar neurons
  - inner layer: ganglion cells
The Organization of the Retina

(b) Pigmented part of retina

Neural part of retina

Central retinal vein

Central retinal artery

Optic disc

Optic nerve

Sclera

Choroid

Macula lutea

Fovea

Optic disc (blind spot)

Central retinal artery and vein emerging from center of optic disc

(c)
The Visual Pathways

- Optic nerve (II)
- Optic chiasm
- Optic tract
- Lateral geniculate nucleus
- Superior colliculus
- Suprachiasmatic nucleus
- Lateral geniculate nucleus
- Projection fibers (optic radiation)
- Visual cortex of cerebral hemispheres
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Central Retinal Artery Occlusion
Central Retinal Vein Occlusion
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 Dry AMD
 Wet AMD
Overview

- Dry AMD
- Wet AMD
Vitamins for Dry AMD

- AREDS 2
  - Vitamin C - 500 mg
  - Vitamin E - 400 IU
  - Beta-Carotene - 15 mg [AREDS2 is testing without this too]
  - Zinc - 80 mg
  - Copper - 2 mg
  - Lutein - 10 mg
  - Zeaxanthin - 2 mg
  - DHA - 350 mg
  - EPA - 650 mg
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- Dry AMD
- Wet AMD
Molecular Pathogenesis of CNV
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Diabetic Retinopathy

- Diabetic retinopathy is the most common cause of new cases of blindness among adults 20-74 years of age.
- Each year, between 12,000 to 24,000 people lose their sight because of diabetes.
- During the first two decades of disease, nearly all patients with type 1 diabetes and over 60% of patients with type 2 diabetes have retinopathy.
Risks of Diabetic Retinopathy Related Vision Loss

- **Duration of diabetes disease**
  - WESDR demonstrated that type 1 patients experience a 25% rate of retinopathy after 5 years of disease, and 80% at 15 years of disease\(^1\)
  - Up to 21% of newly diagnosed type 2 patients have some degree of retinopathy at time of diagnosis\(^1\)

- **Puberty**
- **Pregnancy**
- **Lack of appropriate ophthalmic examination**

\(^1\)American Diabetes Association: Retinopathy in Diabetes (Position Statement). *Diabetes Care* 27 (Suppl.1): S84-S87, 2004
Retinopathy Screening

- Type 1 diabetes - screen within 3-5 years of diagnosis after age 10\(^1\)
- Type 2 diabetes - screen at time of diagnosis\(^1\)
- Pregnancy - women with preexisting diabetes should be screened prior to conception and during first trimester\(^1\)
- Follow-up annually; less frequent exams (2-3 yrs) may be considered\(^1\)
- Examination Methods - Dilated indirect ophthalmoscopy coupled with biomicroscopy and seven-standard field stereoscopic 30° fundus photography\(^1\)

\(^1\)American Diabetes Association: Retinopathy in Diabetes (Position Statement). *Diabetes Care* 27 (Suppl.1): S84-S87, 2004
CLINICAL CLASSIFICATION OF DIABETIC RETINOPATHY

- Background
- Pre-proliferative
- Proliferative
- End-stage diabetic eye disease
Natural History of Diabetic Retinopathy

- Mild nonproliferative diabetic retinopathy (NPDR)
- Moderate NPDR
- Severe NPDR
- Very Severe NPDR
- Proliferative diabetic retinopathy (PDR)
Mild NPDR

Clinical Findings

- Increased vascular permeability
- Microaneurysms
- Intraretinal hemorrhages
- Clinically Significant Macular Edema (CSME) possible

Management/Treatment

- Annual follow-up
- If CSME present: color fundus photography, fluorescein angiography, and photocoagulation
Moderate NPDR

Clinical Findings
- Venous caliber changes
- Intraretinal Microvascular Abnormalities (IRMAs)
- CSME possible

Management/Treatment
- 6-12 month follow-up without CSME
- Color fundus photography
- CSME present: color fundus photography, fluorescein angiography, focal photocoagulation, 3-4 month follow-up
Severe/Very Severe NPDR

Clinical Findings
- Retinal ischemia
- IRMAs
- Extensive hemorrhage and microaneurysms
- CSME possible

Management/Treatment
- 3-4 month follow-up
- Color fundus photography
- Possible panretinal photocoagulation
- CSME present: color fundus photography, fluorescein angiography, focal photocoagulation, 3-4 month follow-up
Clinical Findings

- Ischemia induced neovascularization
  - at the optic disk (NVD)
  - elsewhere in the retina (NVE)
- Vitreous hemorrhage
- Retinal traction, tears, and detachment
- CSME possible
Management/Treatment

- 2-4 month follow-up
- Color fundus photography
- Panretinal photocoagulation (3-4 month follow-up)
- Vitrectomy
- CSME present: focal photocoagulation, fluorescein angiography
Prevention of Diabetic Retinopathy Associated Vision Loss

- Intensive glycemic control
- Tight blood pressure control (<130/80 mmHg)
- Comprehensive eye examinations
Pathogenesis of diabetic retinopathy

1. Basement membrane thickening
2. Endothelial cell damage
3. R.B.C. changes
4. Platelet stickiness increased

Loss of pericytes
Consequences of retinal ischaemia

- Hypoxic retina
- "Vasoformative Substance"
- Rubeosis iridis
- Proliferative retinopathy
Consequences of chronic leakage
Location of lesions in background diabetic retinopathy
Background

- Blot haemorrhage
- Exudate
- Microaneurism
Signs of background diabetic retinopathy

- Microaneurysms usually temporal to fovea
- Intraretinal dot and blot hemorrhages
- Hard exudates frequently arranged in clumps or rings
- Retinal edema seen as thickening on biomicroscopy
lipid exudate  intraretinal hemorrhages

Focal diabetic maculopathy

- Circumscribed retinal thickening
- Associated complete or incomplete circinate hard exudates
- Focal leakage on FA
- Focal photocoagulation
- Good prognosis
neovascularization  capillary nonperfusion


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Diffuse diabetic maculopathy

- Diffuse retinal thickening
- Frequent cystoid macular edema
- Variable impairment of visual acuity

- Generalized leakage on FA
- Grid photocoagulation
- Guarded prognosis
Ischemic diabetic maculopathy

- Macula appears relatively normal
- Poor visual acuity

- Capillary non-perfusion on FA
- Treatment not appropriate
Clinically significant macular edema

Retinal edema within 500 µm of centre of fovea

Retinal edema one disc area or larger any part of which is within one disc diameter (1500 µm) of centre of fovea

Hard exudates within 500 µm of centre of fovea with adjacent edema which may be outside 500 µm limit
<table>
<thead>
<tr>
<th>Grid treatment</th>
<th>Focal treatment</th>
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<tr>
<td>- For diffuse retinal thickening located more than 500 ( \mu m ) from center of fovea and 500 ( \mu m ) from temporal margin of disc</td>
<td>- For microaneurysms in centre of hard exudate rings located 500-3000 ( \mu m ) from center of fovea</td>
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<tr>
<td>- Gentle burns (100-200 ( \mu m ), 0.10 sec), one burn width apart</td>
<td>- Gentle whitening or darkening of microaneurysm (100-200 ( \mu m ), 0.10 sec)</td>
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Pre-proliferative

- Vascular tortuosity
- Haemorrhage
- CWS
- Microaneurism
Preproliferative diabetic retinopathy

<table>
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<th>Signs</th>
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<tr>
<td>• Cotton-wool spots</td>
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<td>• Venous irregularities</td>
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<td>• Dark blot hemorrhages</td>
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<tr>
<td>• Intraretinal microvascular abnormalities (IRMA)</td>
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**Treatment** - not required but watch for proliferative disease
Proliferative diabetic retinopathy

- Affects 5-10% of diabetics
- IDD at increased risk (60% after 30 years)

Neovascularization

- Flat or elevated
- Severity determined by comparing with area of disc

Neovascularization of disc = NVD

Neovascularization elsewhere = NVE
Proliferative retinopathy

- NVD
- NVE
- Pre-retinal haemorrhage
- Laser burn scars
Indications for treatment of proliferative diabetic retinopathy

- NVD > 1/3 disc in area
- Less extensive NVD + haemorrhage
- NVE > 1/2 disc in area + haemorrhage
Laser panretinal photocoagulation

- Initial treatment is 2000-3000 burns
- Spot size (200-500 µm) depends on contact lens magnification
- Gentle intensity burn (0.10-0.05 sec)
- Area covered by complete PRP
- Follow-up 4 to 8 weeks
TREATMENT

- LASER: Light Amplification by the Stimulated Emission of Radiation
  - Focal
  - Grid
  - Panretinal photocoagulation
Assessment after photocoagulation

**Poor involution**
- Persistent neovascularization
- Hemorrhage
- Re-treatment required

**Good involution**
- Regression of neovascularization
- Residual ‘ghost’ vessels or fibrous tissue
- Disc pallor
Indications for vitreoretinal surgery

Severe persistent vitreous hemorrhage

Dense, persistent premacular hemorrhage

Progressive proliferation despite laser therapy

Retinal detachment involving macula
Advanced diabetic eye disease

Preretinal fibrosis and tractional retinal detachment

Rubeosis iridis
End-stage diabetic eye disease

- **PHTHESIS**
  - Shrunken, soft eye with opaque vascularised cornea and no visual potential
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