Care of the Diabetic Patient

Pennsylvania Diabetes Primer
DEFINITION DIABETES MELLITUS
- A group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion and / or increased cellular resistance to insulin.

DIAGNOSTIC CRITERIA
- Symptoms of diabetes plus a casual Plasma Glucose (PG) of 200 mg/dL or >
- Fasting Plasma Glucose (FPGA0 > 126 mg/dL with confirmation on a different day
- Oral Glucose Tolerance Test (OGTT) with 2 hour values > or = 200 mg/dL using a 75 g glucose challenge

TERMINOLOGY
- **Type 1 diabetes mellitus (T1DM)**
  - 10% of all diabetics in US
  - As a result of destruction of pancreatic Beta cells leading to a total insulin deficiency
    - Immune mediated disease T1DM
      - Islet cell antibodies
      - Insulin auto-antibodies
      - Glutamic acid decarboxylase antibodies
      - Associated with HLA
    - Idiopathic T1DM
      - No autoimmune markers defined
      - Not HLA associated
      - Strong inheritance with African and Asian predilection
  - Can occur at any age but is most common under the age of 30 years
  - Requires exogenous insulin to prevent ketoacidosis
  - “Type 1.5 diabetes mellitus”
    - Latent autoimmune diabetes in adults (LADA)
      - Later onset than classical T1DM
      - 5-10% of all diabetics
      - Share insulin resistance with T2DM but lower BMI, triglycerides, BP and a more severe defect in stimulated beta-cell capacity than patients with classical T2DM
      - Similar to T1DM in regard to associations with high risk HLA genotypes and autoimmune phenomena (GAD, IA2, ICA)
      - Progression to insulin dependence

- **Type 2 diabetes mellitus (T2DM)**
  - Most common form of DM worldwide
  - Approximately 90% all cases of DM in the US
  - Upper body obesity is a risk factor
  - Incidence increases with age (> 40 years), however, increasing prevalence in children in high risk ethnic groups
    - Native Americans, Hispanic Americans, African Americans, Asian Americans
      - Most aged 10 – 19 years
      - Obese
      - FHx of DM
      - Acanthosis nigricans
  - Metabolic defects vary
    - Insulin resistance with relative insulin deficiency
    - Insulin secretory defect with insulin resistance
Insulin resistance syndrome
- Glucose intolerance
- Hypertension
- Dyslipidemia (High TG, Low HDL, High LDL)
- Increased Plasminogen activator inhibitor (PAI-1)
- Reduced sex binding globulin
- Coronary artery disease
- Diffuse atherosclerosis

Metabolic syndrome – the presence of three or more components
- Abdominal obesity
  - Males: waist circumference ≥ 40 inches
  - Females: waist circumference ≥ 35 inches
- Atherogenic dyslipidemia
  - Elevated triglycerides: ≥ 150 mg/dL
  - Low HDL / high LDL
    - HDL levels
      - Males < 40 mg/dL
      - Females < 50 mg/dL
- Elevated blood pressure ≥ 130/85 mmHg
- Insulin resistance or glucose intolerance
  - Elevated fasting PG ≥ 100 mg/dL
- Prothrombic state
  - Elevated fibrinogen or plasminogen activator-1
- Proinflammatory state
  - Elevated CRP

Impaired glucose intolerance (IGT) / Impaired fasting glucose (IFG)
- IGT - FPG > 110 mg/dL but <126 mg/dL and the 2 hour value of OGTT is > 140 mg/dL but < 200 mg/dL
- IFG - FPG > 110 mg/dL but <126 mg/dL
- HbA1C values often normal in both
- Not associated with micro-vascular complications of DM but is linked to micro-vascular disease

Gestational diabetes mellitus
- Any degree of glucose intolerance with onset or first diagnosis during pregnancy; usually in the second or third trimester
- Screening performed at 24 – 28 weeks OGTT using a 50 g glucose challenge
  - One hour values ≥ 140 mg/dL require full dx testing using a 100 g challenge
  - Dx: FPG > or = 105 mg/dL; 1 hour OGTT > 190 mg/dL; 2 hour > 165 mg/dL; 3 hour > 145 mg/dL
  - Dx positive when any 2 of these values are exceeded
- Incidence approximately 4% with a prevalence on 1-14% depending on the population considered
- OGTT usually returns to normal by 6 weeks post parturition

Other specific types of diabetes
- Secondary to:
  - Genetic defects of beta cell function / insulin action
  - Pancreatic disease
  - Endocrinopathies
  - Medications
  - Toxic chemicals
  - Other immune mediated diabetes
  - Anti-insulin receptor antibodies
TREATMENT OF DIABETES MELLITUS

- Goal: maintenance of normal / near normal PG levels throughout the day
  - HbA1c < 7
  - Blood pressure < 130 / 85
  - Cholesterol
    - LDLs < 100
    - If cardiac < 70
- Multimodal treatment
  - Diet / nutritional therapy – dietician consult
  - Exercise
  - Oral medications
  - Insulin
- Weight loss / nutritional tx may be sufficient to control PG in some T2DM patients
- Oral therapies
  - Sulfonylurea compounds: 1st, 2nd and 3rd generation (Glyburide, Glipizide)
  - Biguanides: metformin / phenformin (Glucophage, Glucovance)
  - Alpha glucosidase inhibitors: acarbose / miglitol (Precose, Glyset)
  - Glitazones: pioglitazone / rosiglitazone (Actos, Advandia)
  - Meglitinides: epaglinide / nateglinide (Prandin, Starlix)
  - Dipeptidyl peptidase IV inhibitors: vildagliptin / sitagliptin (Galvus, Januvia)
- Injectables
  - Incretins: exenatide (Byetta)
  - Amylin: (Symlin)
  - Insulin
  - Lyspro, novalin, humalin, NPH, Lente, Ultralente
  - Required for all T1DM and T2DM patients unresponsive to diet / oral medications
  - Administered conventionally BID, multiple pre-meal and bedtime injections or with sub-q infusion pump
- Combination therapy
  - Oral and injectable modalities provide synergy b/t medications while reducing side effects
- Clinical trials
  - Diabetes Control and Complications Trail
  - Kumamoto Study
  - Stockholm Diabetes Intervention Study
  - United Kingdom Prospective Diabetes Study
  - Collectively, these studies showed that
    - There is no glycemic threshold for the development of microvascular complications
    - Intensive therapy resulted in better glycemic control and decreased DR

### Standards for Glycemic Control

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<td>80-120</td>
<td>&lt;80 or &gt;140</td>
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<tr>
<td>Bedtime glucose (mg/dl)</td>
<td>&lt;120</td>
<td>100-140</td>
<td>&lt;100 or &gt;160</td>
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<td>Glycosylated Hemoglobin (HbA1c)</td>
<td>&lt;6</td>
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Epidemiology

- Leading cause of legal blindness in working age adults (aged 24 – 70 years)
- Account for 12% of new cases of blindness each year
- Almost 20 million Americans age 20+ diagnosed or undiagnosed
- ~ 1/3 to 1/2 are unaware they have diabetes
- An additional 26% have impaired fasting glucose
- Higher prevalence in African Americans and Mexicans vs. Americans of European decent
- Very high prevalence of diabetes in Native American Indians & Native Alaskans
- Increased frequency of T2DM parallels increases in childhood obesity
- Prevalence of retinopathy age 40+: 3.4%
- Prevalence of vision threatening DR: 0.75%

Screening for Diabetes Mellitus

- Screening with FPG after 8 hour fast
- Confirm positive results
- Screen individuals with high risk characteristics:
  - Age ≥ 45 years
  - Obesity > 120% of desirable body weight or BMI > 27
  - First degree relative with DM
  - High risk ethnic group: African American, Native American, Hispanic
  - Delivered a baby > 9lbs. or Dx with GDM
  - Hypertensive
  - HDL < 35mg/dl and / or triglycerides > 250mg/dL Previously dx'ed IGT or IFG
- Urine glucose or HbA1c should not be used for screening

Ocular and Visual Complications of Diabetes Mellitus

- Functional
  - Tritan color deficiency
  - Changes in refractive error or
  - Accommodative dysfunction
  - Visual field defects
- EOM anomalies
  - Mononeuropathies of CN III, CN IV, or CN VI
- Pupillary reflexes
  - Sluggish papillary reflexes
  - Possible afferent defects
- Conjunctiva
  - Microaneurysms of the bulbar conjunctiva
- Tear film
  - Tear film deficiencies resulting in DES
- Cornea
  - Reduced corneal sensitivity
  - Reduced corneal wound healing ability
  - Basement membrane abnormalities – RCE / increased frequency of abrasion
  - Wrinkling of Decemet’s membrane
  - Changes in endothelial cell morphology – increased corneal thickness
- Iris
  - Depigmentation
  - NVI, ectropian uvea, PAS
  - Neovascular glaucoma
Ocular and Visual Complications of Diabetes Mellitus, continued

- Lens
  - Higher prevalence of cataract
  - Reversible lenticular opacities
  - Snowflake cataract
- Vitreous
  - Vitreous hemorrhage in PDR
- Optic nerve
  - Papillopathy with or without APD
  - Ischemic optic neuropathy
    - AION – disc pallor, swelling, hemorrhages, acutely decreased VA, APD and altitudinal visual field defect
    - Retrobulbar ION is uncommon
  - Higher incidence of open angle glaucoma
- Retina
  - NPDR
  - PDR
  - ME
  - Diabetic maculopathy
  - Macular pucker
  - Macular hole
  - Retinal / macular detachment

RISK FACTORS FOR DEVELOPMENT / PROGRESSION OF DIABETIC RETINOPATHY

- Duration of diabetes – **Major risk factor for the development of DR**, once present, less important than severity of hyperglycemia for progression
  - T1DM
    - After 5 years 25% have DR
    - After 10 years 60%
    - After 15 years 80%
    - PDR in 50% at 20 years
    - At 15+ years 18% of Hispanics – PDR
  - T2DM
    - At diagnosis 20% have retinopathy
    - Known duration < 5 years
      - On insulin 40% with DR increasing to 84% up to 19 years
      - On oral hypoglycemics 24% DR increasing to 54% up to 19 years
      - 2% with PDR increasing to 25% at 25+ years
    - > 4 years: 4% progress to proliferative retinopathy
    - > 15 years: 60-80% have some retinopathy with up to 20% progressing to proliferative retinopathy

- Severity of hyperglycemia – **Key alterable risk factor for the development and progression of DR**
- Poor glycemic control
- DM > 15 years
- Concomitant hypertension
- Pregnancy
- Anemia
- Renal disease
- Hyperlipidema / cholesterolemia
- Exercise
- Smoking
- HbA1C > 8.0
- Uncontrolled hypertension
Risk factors for development / progression of diabetic retinopathy, continued

- Diabetic nephropathy
- Gross proteinuria
- On dialysis
- S/P Renal Transplant
- Lower extremity amputation related to DM
- Hx of diabetic retinopathy
- Hx of laser for diabetic retinopathy
- Pregnancy and pre-existing DM
- T2DM with CV autonomic neuropathy
- Insulin dependence
- Obesity
- ? Female
- African Americans, Native Americans and the elderly

NATURAL HISTORY

- Diabetic eye disease is considered end organ damage secondary to a systemic disease
- Diabetic retinopathy progresses in a predictable fashion without intervention
- Approximately 5% develop glaucoma compared to 2% of the general population
- Cataract is 2-4 times more prevalent, occur earlier in life and progress more rapidly than the general population
- Nonproliferative diabetic retinopathy findings:
  - MA’s
  - Intraretinal hemorrhages
  - Cotton-wool spots
  - Hard exudates in later stages with increased vascular permeability
  - CSDME

INTERNATIONAL CLINICAL DIABETIC RETINOPATHY DISEASE SEVERITY SCALE

- No apparent retinopathy
- Non-proliferative diabetic retinopathy (NPDR)
  - Mild NPDR – MA’s only
    - 5% risk of progression to PDR in 1 year
    - 15% risk of progression to PDR in 5 years
  - Moderate NPDR
    - More than just MA’s and less than severe NPDR
    - 12-27% risk of progression to PDR in 1 year
    - 33% risk of progression to high risk NPDR in 5 years
  - Severe NPDR – (4-2-1 Rule without signs of PDR)
    - MA’s and severe intraretinal hemorrhages in each on 4 quadrants
    - Definite venous beading in 2 or more quadrants
    - Moderate IRMA in 1 or more quadrants
    - 52% risk of progression to PDR in 1 year
    - 60% risk of progression to high risk PDR in 5 years

- Venous beading / looping, IRMA, Extensive retinal hemorrhage and exudation are all signs of impaired perfusion and / or retinal ischemia
- Venous caliber abnormalities are indicative of severe retinal hypoxia and is a risk factor for progression to PDR
- IRMA serve as shuts through areas of nonperfusion and are a harbinger to NV
International Clinical Diabetic Retinopathy Disease Severity Scale, continued

- Very severe NPDR
  - Two or more findings of severe NPDR

- Proliferative diabetic retinopathy (PDR)
  - One or both of:
    - Neovascularization – NVD, NVE fibrous proliferation
    - Vitreous / pre-retinal hemorrhage
    - 75% risk that PDR that has not achieved high risk level will become high risk in 5 years

INTERNATIONAL CLINICAL DIABETIC MACULAR EDEMA DISEASE SEVERITY SCALE

- Diabetic macular edema absent
- Diabetic macular edema present that is represented by retinal thickening or hard exudates
  - Mild diabetic macular edema
    - Some retinal thickening or hard exudates in the posterior pole but distant from the macula
  - Moderate diabetic macular edema
    - Retinal thickening or hard exudates approaching the center of the macula but not involving the center
  - Severe diabetic macular edema
    - Retinal thickening or hard exudates involving the center of the macula

- Hard exudates are a sign of current or previous macular edema
- Macular edema is defined as retinal thickening
- Most common cause of reduced acuity / vision loss in the diabetic population
- Early treatment with photocoagulation reduces risk of vision loss by 50-60%
  - CSME is defined as:
    - Thickening of the retina at or within 500 microns of the center of the macula (approximately 1/2 disc diameter from foveola)
    - Hard exudates at or within 500 microns of the center of the macula if associated with thickening of the adjacent retina (not residual hard exudates remaining after the disappearance of retinal thickening)
    - A zone or zones of retinal thickening one disc area or larger, any part of which is within 1 disc diameter of the center of the macula

SYSTEMIC CONSIDERATIONS

- Glycemic control
  - Tight PG control via intensive therapy results in the significant reduction for risk of developing severe NPDR, vitreous hemorrhage, renal failure, PDR, CSME or need for photocoagulation
  - Similar results were found for T1DM and T2DM
  - HbA1C values of ~7.0 were defined as adequate in these studies, more recently values closer to 6.0 have been considered more appropriate
- Type of diabetes
  - T1DM: Absolute insulin deficiency
    - Diagnosis on or before the age of 30 requiring continuous insulin use
    - Suggestion that early vitrectomy for vitreous hemorrhage may be more advantageous for T1DM vs. T2DM. Newer technology may nullify this finding.
  - T2DM: Insulin resistance or a state of relative insulin deficiency
    - Early PRP (prior to the development of high risk PDR) in Type 2 patients with severe, very severe NPDR or early PDR were afforded a 50% reduction in the risk of severe vision loss over 5 years. This risk reduction was not observed in T1DM patients.
Systemic Considerations, continued

- Concomitant hypertension
  - Significant risk factor for the development / progression of diabetic retinopathy especially in African Americans
  - Prevalence / Incidence of hypertension in the diabetic population
  - Type 1: 17% and 25% incidence after 10 years
  - Type 2: 38% - 68% prevalence
  - About 2/3 of epidemiological studies examining either Type 1 and/or Type 2 diabetics have shown that either systolic or diastolic HTN influence the development or progression of diabetic retinopathy
  - Diastolic pressure may be more important in Type 1 diabetics and systolic pressure of import in Type 2's
  - Cross sectional and prospective studies have failed to show an association between HTN and diabetic retinopathy in elderly Type 2 patients
  - UKPDS: Intensive BP control resulted in a 34% reduction in progression of diabetic retinopathy and 47% reduction in risk for moderate vision loss
  - ACE inhibitors and B-blockers both resulted in the reduction of diabetic retinopathy independent of glycemic control
  - ACE inhibitors provide a 50% reduction in progression to end stage renal disease (ESRD)
  - Target BP as low as safely possible
  - The need to optimize hypertension control should be stressed by the eye care professional

- Renal disease
  - A strong relationship exists between proteinuria, microalbuminuria and diabetic retinopathy
  - Elevated BP is a risk factor for both diabetic retinopathy and microalbuminuria
  - Rapidly progressing retinopathy which was previously stable in a long duration diabetic is suspicious for renal disease and consultation should be sought

- Anemia
  - ETDRS - Low hematocrit was an independent risk factor for the development of high risk DR and vision loss
  - Reports of rapid progression of DR with the development of iron deficient anemia
  - ECP should ensure that patients with DR and anemia are well managed

- Hyperlipidemia / Cholesterolemia
  - Risk factor for diabetic renal disease
  - Cholesterol levels associated with the severity of hard exudates but not the severity of DR in T1DM or T2DM
  - ETDRS – elevated serum cholesterol, HDL's and triglycerides associated with faster development of exudates
    - Moderate vision loss was associated with extent of exudates

- Pregnancy
  - Transient rapid progression of retinopathy
  - Long term risk of progression appears unaffected
  - Increasing severity of DR at baseline affects pregnancy outcomes
  - PRP may be considered in patients approaching PDR and considering pregnancy

- Exercise
  - Generally, exercise has not been shown to accelerate DR
  - Patients with PDR should avoid anaerobic exercise
  - Induced complications due to exercise include
    - Hypoglycemia
    - Hyperglycemia
    - Ketosis
    - Cardiac ischemia
    - Complications associated with PDR

- Anti-coagulation
  - ASA as an anticoagulant in diabetics has not been shown to increase the risk of hemorrhage or impact progression of retinopathy / macular edema

- Smoking
  - Risk factor for cardiovascular disease, albuminuria, protienuria and nephropathy
  - Inconsistent relationship b/t smoking and retinopathy
  - Because of the cardiovascular risk factors smoking should be discouraged in DM patients
PREVENTION

♦ Educate patients regarding importance of tight PG and BP control
♦ EDTRS found that ASA tx @ 650 mg QD was of no benefit to retard progression of DR and **did not** increase the severity of vitreous hemorrhage in PDR

- **T1DM**
  - Maintain good glycemic control / monitor HbA1c
    - Early Intense therapy vs. conventional therapy
      - 75% reduction in the rate of development of DR by 75% in those individuals without DR
      - 50% reduction in the rate of progression in those individuals with existing retinopathy
    - May be some early transient worsening of DR but no effect on acuity with a 5x decreased risk of progression at 3.5 years that persisted to the end of the 10 year observational period
  - Consistent ophthalmic evaluation over time as recommended to prevent severe vision loss

- **T2DM**
  - Optimize BMI
  - Maintain good glycemic control / monitor HbA1c
    - 29% reduction in the need for photocoagulation with early intensive therapy vs. conventional
  - Maintain tight BP control
    - 34% reduction in the risk of progression of DR
    - 47% reduction in risk of severe vision loss
    - No difference between the use of ACE inhibitors and B-blockers to lower BP in progression of DR or final VA
  - Consistent ophthalmic evaluation over time as recommended to prevent severe vision loss

CARE

- **Outcome criteria**
  - Maintain / improve / stabilize visual function - vision related quality of life
  - Coordination of care to achieve optimum glycemic control

- **Diagnosis**
  - Evaluation
    - History
    - Duration of diabetes
    - Indicators of past glycemic control: HbA1C
    - Medications
    - Medical Hx with particular attention to obesity, renal disease, HTN, lipid levels, pregnancy
    - Ocular Hx with particular attention to previous ocular injections, retinal laser, refractive surgery and trauma
  - Ophthalmic Examination
    - Visual acuity
    - External
    - Pupillary reflexes
    - Ocular motility - diabetic paresis / 90 days
    - Visual field screening
    - Refraction as indicated
    - Biomicroscopy
      - Red free examination of the iris for NVI prior to dilation
    - Tonometry
    - Gonioscopy when indicated
      - Overt NVI
      - Elevated IOP
      - A red free beam may obviate fine neovascular vessels
Care, continued

- DFE including stereoscopic evaluation of the posterior pole using slit lamp funduscopy and peripheral regions via binocular indirect ophthalmoscopy or biomicroscopy using a fundus contact lens. Red free filters may be of value in defining fine neovascular vessels.
  - Particular attention should be given to assessing for high risk characteristics including:
    - DME
    - NVD / NVE
    - Severe or very severe NPDR
    - Vitreous / preretinal hemorrhage

- Consider checking BP or carotid auscultation as indicated
- Stereoscopic fundus imaging is helpful in detecting and grading DR
- Always communicate findings with patients health care team and consult as indicated

EXAMINATION FREQUENCY FOR OCULAR MANIFESTATIONS OF DM

- T1DM
  - 3-5 years after diagnosis
  - Yearly thereafter unless abnormal findings dictate for frequent evaluations

- T2DM
  - At the time of diagnosis
    - ~30% will have some level of retinopathy at the time of initial diagnosis
    - ~3% will have CSDME or high risk retinopathy at the time of initial diagnosis
  - Yearly thereafter unless abnormal findings dictate more frequent evaluations

- Pregnancy (T1DM or T2DM)
  - Prior to pregnancy
    - Counsel on the increased risk for the development or progression of diabetic retinopathy
  - During the first trimester with follow-up examination as dictated by level of retinopathy observed
    - No retinopathy to mild / moderate: every 3-12 months
    - Severe NPDR or worse: every 1-3 months
    - Patients with CSDME, moderate to severe NPDR, or PDR require consultation with a retinal specialist
  - Gestational diabetics do not require examination during pregnancy

- Ancillary testing
  - Color fundus imaging – CPT 92250
    - Useful in documenting progression form a baseline image or response to treatment
    - Of limited value in cases of minimal NPDR or no change
  - OCT / RTA / HRT – CPT 92135
    - OCT (Time domain or Spectral domain)
      - Quantification of retina thickness is useful in monitoring / identifying ME, vitreomacular traction and response to treatment
    - RTA
      - Quantification of retina thickness is useful in monitoring / identifying ME, vitreomacular traction in some patients and response to treatment albeit at a lower resolution than OCT
      - It has been shown to be more sensitive to changes in retinal topography than Stratus OCT
    - HRT III Retina Module
      - A measure of retina thickness is useful in monitoring / identifying ME and response to treatment
  - F-ANG
    - As a guide to treatment for CSME but not to diagnose
    - To evaluate unexplained vision loss
    - To identify suspected but clinically occult retinal NV
    - Death as a complication occurs in approximately 1 in 200,000
    - Fluorscein dye crosses the placenta but effects have not been documented
  - B-scan ultrasonography
    - Useful in detecting RD in patients with vitreous hemorrhage or dense cataract
TREATMENT OF RETINAL COMPLICATIONS

- Scientific basis for treatment
  - Diabetic Retinopathy Study (DRS 1971-75)
  - Early Treatment Diabetic Retinopathy Study (ETDRS 1979-90)
  - Diabetic Retinopathy Vitrectomy Study (DRVS 1977-87)
  - Diabetes Control and Complications Trial (DCCT 1983-93)
  - United Kingdom Prospective Diabetes Study (UKPDS 1977-99)

- DRS, ETDRS, and DRVS established the efficacy of laser sx for PDR and DME. Also provided guidelines as to timing of intervention with laser or vitrectomy.
- DCCT and UKPDS established the benefits of intensive PG control to reduce the risk of onset / progression of DR and other complications of T1 and T2DM.
- ETDRS provided a modified and extended Arlie House classification that is the basis of the currently used diabetic retinopathy severity scale.
- Laser photoagulation is the standard treatment for treating diabetic retinopathy. PRP / Focal or Grid many times in conjunction with intravitreal injections.
- For levels of Moderate NPDR or worse any PDR, macular edema, NVI or unexplained vision loss consultation should be sought with a retinal specialist.

- Appendix Figure 1 presents a flowchart for the management of the patient with undiagnosed DM.
- Appendix Figure 2 presents a flowchart outlining the optometric management of the patient diagnosed as having DM.

- None to Minimal
  - Follow-up 12 months.
  - 5% to 10% will develop DR within 1 year and similar findings are found for progression in patients with preexisting DR.
- Mild to Moderate without CSME
  - Monitor 6 – 12 months.
  - Pt’s with ME that is not CS should be re-evaluated in 2-4 months because of increased risk of CSME.
  - Disease progression is common.
  - For mild NPDR 4 year incidence for ME or CSME is ~12%.
  - For moderate NPDR risk of CSME is 23% for either T1DM or T2 DM.
  - Color fundus images are helpful as baseline.

- Mild to Moderate with CSME
  - Monitor 2 - 4 months if pt. declines, cannot comply, the center of macula is not involved or imminently threatened.
  - Color fundus imaging is appropriate to document retinal status.
  - OCT is useful to quantify retinal thickness, detect subtle edema, and to follow treatment response but is not indicated as a screening tool.
  - Consider F-ANG as indicated.
  - Treatment of CSDME:
    - Focal laser.
    - Periocular Kenalog.
    - Intravitreal Kenalog (IVK) - Triscence (Alcon)
      - Increased IOP in 25 – 45%.
      - 1% unresponsive to ocular hypotensives.
    - Anti-VGEF
      - Macugen.
      - Lucentis.
      - Avastin.
    - Vitrectomy for refractory CSME.
    - Combination therapy.
Treatment of Retinal Complications, continued

- Consider Rule of 3s
  - 30% lose 3 lines in 3 years without intervention
  - Laser is better than doing nothing
- Focal or grid laser with the goal to stabilize VA
- Laser - 50% reduction in risk for a 2 line loss of visual acuity (doubling of visual angle) from 30% to 12%
- Patients with CSME should be referred promptly for F-ANG and photocoagulation

*Consultation with a retinologist should be sought in all patients with moderate DR or greater with or without CSDME as the risk of vision loss is greatly increased*

**Severe NPDR and Non-High-Risk PDR**
- 50% with severe NPDR will develop PDR within 1 year and 15% will be high risk PDR
- Consider PRP before the development of high risk PDR
- Early PRP (before evidence of high risk PDR) decreased the risk of severe vision loss or vitrectomy by 50% in T2DM
- PRP may exacerbate ME, focal laser may be performed prior to or concomitantly with PRP
- F-ANG may be utilized to determine areas of non-perfusion, undetected NV and to establish the cause for decreased VA
- Other imaging modalities may be useful in tracking treatment response
- RNFL appearance may change but no significant changes in disc contour or C/D ratio has been documented from PRP
- Optic disc pallor may s/p PRP or spontaneously with quiescent PDR without alteration in C/D ratio
- Monitor 2-4 months after successful treatment

**High Risk PDR**
- Defined:
  - NVD or NVE within 1 DD of optic nerve that are larger than 1/3 the area of the optic disc
  - Vitreous or preretinal hemorrhage associated with less extensive NVD or NVE ½ disc are or larger
- PRP should be performed without delay – immediate referral
- In patients with CSME focal laser may be performed concomitantly with PRP
- Early vitrectomy is indicated in patients with vitreous opacities and active NV / NVI and advantageous in patients with extensive fibrovascular proliferation.

**High Risk PDR not amendable to photocoagulation**
- Vitreous hemorrhage precluding visualization of the retina, traction macular detachment, active proliferation of neovascularization, fibrovascular proliferation

**COMPLICATIONS OF TREATMENT**

- **Focal Laser photocoagulation for DME**
  - Initial decrease in central vision
  - Paracentral scotomas / depressions if laser burns have been placed close to the fovea...large confluent burns
  - Permanent central scotoma due to inadvertent foveal burn
  - Rarely focal will induce subretinal fibrosis with choroidal NV
- **PRP for severe NPDR or PDR**
  - Loss of central vision from macular edema
  - Peripheral field constriction with poor dark adaptation
  - Vitreous hemorrhage in NV is present
  - Loss of accommodation
- **Vitrectomy**
  - Recurrent vitreous hemorrhage
  - Retinal detachment
  - NVI
  - Severe vision loss
Complications of Treatment, continued

- Microbial endophthalmitis
- Cataract

- Intravitreal injections
  - Cataract progression with intravitreal corticosteroids
  - Elevated IOP with intravitreal corticosteroids
  - Infectious endophthalmitis
  - Transient sterile inflammatory reactions
  - Possible systemic effect form intravitreal medication

- Other Treatments
  - Protein kinase inhibitors
  - GH agonists
  - Intravitreal injections – most promising as adjunctive to laser and vitrectomy
  - Anti-VGEF
  - Corticosteroids
Management of Non-retinal Ocular Complications

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<th>Category</th>
<th>Ocular Complication</th>
<th>Management</th>
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<tr>
<td>Functional</td>
<td>Tritan color vision loss</td>
<td>DFE to rule out diabetic maculopathy; counseling; low vision evaluation; review of independent living aids as necessary</td>
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<td></td>
<td>Refractive error changes; Accommodative dysfunction</td>
<td>Consult with patients’ physician regarding PG control; modification of spectacle Rx as necessary</td>
</tr>
<tr>
<td></td>
<td>Visual field defects</td>
<td>Low vision evaluation; orientation and mobility training as necessary</td>
</tr>
<tr>
<td>Extra-ocular muscle anomalies</td>
<td>Mononeuropathies</td>
<td>Neuro or neuro-ophthalmology consultation; temporary prism spectacle / eye patching as indicated</td>
</tr>
<tr>
<td>Pupils</td>
<td>Sluggish papillary reflexes; Afferent papillary defects</td>
<td>Workup to rule out optic neuropathy</td>
</tr>
<tr>
<td>Conjunctiva</td>
<td>Bulbar microaneurysms</td>
<td>Monitor</td>
</tr>
<tr>
<td>Tearfilm</td>
<td>Dry eye syndrome</td>
<td>Manage dry eye; AT’s – ocular lubricants and other DES techniques; Monitor for corneal complications</td>
</tr>
<tr>
<td>Cornea</td>
<td>Reduced corneal sensitivity</td>
<td>Monitor for abrasions, keratitis, or other ulcerations</td>
</tr>
<tr>
<td>Note: Monitor all corneal insults closely for 2’ infection /delayed wound healing particularly in CL patients</td>
<td>CEBMD / RCE</td>
<td>Hypertonic saline – UNG; Patching / bandage CL as indicated</td>
</tr>
<tr>
<td></td>
<td>Wrinkling of Decemet’s membrane</td>
<td>Monitor</td>
</tr>
<tr>
<td></td>
<td>Endothelial cell changes</td>
<td>Monitor</td>
</tr>
<tr>
<td>Iris</td>
<td>Depigmentation</td>
<td>Monitor – routine tonometry and gonioscopy</td>
</tr>
<tr>
<td>NVI</td>
<td>Monitor r/o chamber angle involvement/ DFE – evaluate for PDR; Consult with retinal specialist</td>
<td>Gonioscopy</td>
</tr>
<tr>
<td>Lens</td>
<td>Cataract</td>
<td>Monitor; Consult with ophthalmology if VA is impaired due to media opacity or fundus view in significantly impaired</td>
</tr>
<tr>
<td>Vitreous</td>
<td>Hemorrhage</td>
<td>DFE; Consultation with retinal specialist</td>
</tr>
</tbody>
</table>
FOLLOW-UP CARE

- **History**
  - Symptoms / flux in VA
  - Systemic status
    - Pregnancy
    - BP
    - Cholesterol
    - Renal status
    - Change in meds
  - Glycemic status (HbA1C value)

- **Examination**
  - Visual acuity
  - External
  - Pupillary reflexes
  - Ocular motility - diabetic paresis / 90 days
  - Visual field screening
  - Refraction as indicated
  - Biomicroscopy with special attention for NVI
  - Tonometry
  - Gonioscopy as indicated
  - DFE with stereoscopic examination of the posterior pole via BIO and/or Slit-lamp funduscopic examination
  - Peripheral retinal and vitreous examination via BIO
    - Red free filters may be helpful in identifying NV

- **Provider**
  - Optometrists, as the primary eye care provider, must be cognizant and familiar with the recommendations of the ETDRS, UKPDS, and DCCT/EDIC studies.

- **Coding**
  - See Appendix Figure 3 for ICD-9-CM classifications
  - Examination
    - CPT
    - Frequency: defined by major study recommendations
  - Imaging
    - CPT
    - Frequency: DR greater than mild or ME to identify of document change in status

- Medicare Physician Quality Reporting Initiative (PQRI)
  - See PQRI section of Pennsylvania Diabetic Eye Health Alliance packet
  - Communication of examination results to managing physician is critical
  - For adult diabetes: Determination of HbA1c
  - Ask patient about glycemic control (? Last HbA1C value)
  - Reinforce the need for tight glycemic control for decrease risk for progression of DR

- Managing VCP refractive services

- Counseling / Referral
  - Individuals with a PCP
  - Individuals without a PCP
  - Podiatric consultation
  - Dental consultation
PATIENT EDUCATION

- ECP’s should educate their patients:
  - The natural history of DR
  - The relationship and importance of tight PG control in regard to ocular and systemic complications of the disease
  - Specific HbA1c levels should be discussed indicating that a 1% rise in this measure infers a 44% increase in the risk of progression of DR over a 10 year period
  - Patients should be informed about resources and support organizations for patients with DM
  - Consider psychosocial counseling for patients that have difficulty dealing with the issues surrounding their disease / diabetic retinopathy

RESOURCES

American Optometric Association, Optometric Clinical Practice Guideline – Care of the Patient with Diabetes Mellitus 3rd Ed. August 2002


http://www.americanheart.org/presenter.jhtml?identifier=4756
Figure 1

Optometric Management of the Patient
With Undiagnosed Diabetes: A Brief Flowchart

Patient assessment

Suspect undiagnosed diabetes

No ocular manifestations

Request fasting blood glucose or refer

Fasting blood glucose <110 mg/dl

Schedule followup eye examination

Fasting blood glucose 110-126 mg/dl

Retest fasting blood glucose

Fasting blood glucose ≥126 mg/dl

Refer to physician for evaluation

Ocular manifestations

Non-retinal abnormality

Non-proliferative retinopathy

Proliferative retinopathy

Manage or refer per Guideline

Refer to physician for treatment of diabetes

Figure 2
Optometric Management of the Patient
With Diagnosed Diabetes Mellitus: A Brief Flowchart

Diabetes mellitus 250
Excludes: gestational diabetes (648.8)
hyperglycemia NOS (790.6)
neonatal diabetes mellitus (775.1)
nonclinical diabetes (790.2)
The following fifth-digit subclassification is for use with category 250:
0 type II [non-insulin dependent type][NIDDM type][adult-onset type] or unspecified type, not stated as uncontrolled
Fifth-digit 0 is for use for type 2, adult-onset, diabetic patients, even if the patient requires insulin
1 type I [insulin dependent type][IDDM type][juvenile type], not stated as uncontrolled
2 type II, [non-insulin dependent type][NIDDM type][adult–onset type] or unspecified type, uncontrolled
Fifth-digit 2 is for use for type II, adult-onset, diabetic patients, even if the patient requires insulin
3 type I [insulin dependent type][IDDM][juvenile type], uncontrolled

Diabetes with ophthalmic manifestations 250.5
Use additional code, if desired, to identify manifestation, as:
  diabetic:
    blindness (369.00-369.9)
    cataract (366.41)
    glaucoma (365.44)
    retinal edema (362.83)
    retinopathy (362.01-362.02)

Diabetic retinopathy 362.0
Code first diabetes (250.5)

continued on next page

## Figure 3, continued

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>362.01</td>
<td>Background diabetic retinopathy</td>
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<tr>
<td>362.01</td>
<td>Diabetic macular edema</td>
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<td>362.01</td>
<td>Diabetic retinal edema</td>
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<td>362.01</td>
<td>Diabetic retinal microaneurysms</td>
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<td>362.01</td>
<td>Diabetic retinopathy NOS</td>
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<td>362.02</td>
<td>Proliferative diabetic retinopathy</td>
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<td>362.14</td>
<td>Retinal microaneurysms NOS</td>
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<td>Retinal telangiectasia</td>
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<td>362.16</td>
<td>Retinal neovascularization NOS</td>
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<td>Other intraretinal microvascular abnormalities</td>
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<td>Retinal varices</td>
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<td>362.81</td>
<td>Retinal hemorrhage</td>
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<td>Hemorrhage:</td>
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<td>362.81</td>
<td>preretinal</td>
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<td>retinal (deep) (superficial)</td>
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<td>subretinal</td>
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<td>362.82</td>
<td>Retinal exudates and deposits</td>
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<td>362.83</td>
<td>Retinal edema</td>
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<tr>
<td>362.83</td>
<td>Retinal:</td>
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<td>362.83</td>
<td>cotton wool spots</td>
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<td>362.83</td>
<td>edema (localized) (macular) (peripheral)</td>
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<td>362.84</td>
<td>Retinal ischemia</td>
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<td>364.42</td>
<td>Rubeosis iridis</td>
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<tr>
<td>364.42</td>
<td>Neovascularization of iris or ciliary body</td>
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*continued on next page*
### Figure 3, continued

<table>
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<tr>
<th>Condition</th>
<th>Code</th>
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<tr>
<td>Glaucoma associated with systemic syndromes</td>
<td>365.44</td>
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<tr>
<td><em>Code first associated disease</em></td>
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<tr>
<td>Glaucoma associated with vascular disorders</td>
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<tr>
<td>Use additional code for associated disorder</td>
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<tr>
<td>Diabetic cataract</td>
<td>366.41</td>
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<tr>
<td><em>Code first diabetes (250.5)</em></td>
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<tr>
<td>Transient refractive change</td>
<td>367.81</td>
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<td>Diplopia</td>
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<td>Double vision</td>
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<td>Visual field defect, unspecified</td>
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<td>Tritan defect</td>
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<td>Tritanomaly</td>
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<td>Tritanopia</td>
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<td>Recurrent erosion of cornea</td>
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<td>Tear film insufficiency, unspecified</td>
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<td>Dry eye syndrome</td>
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<tr>
<td>Ischemic optic neuropathy</td>
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<tr>
<td>Vitreous hemorrhage</td>
<td>379.23</td>
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</table>