An Interprofessional Approach to Diabetes Management

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Course Goal

- To provide the participant with useful clinical information about caring for patients living with diabetes mellitus.

The eye does not exist in isolation. It is an extension of the brain/CNS.

The anatomy of the eye is structured to serve the functions of the retina.

Primary reason for dilation is to detect systemic disease.

The eye is the only part of the body where neurological and vascular tissues can be viewed directly.

32 yo WM

- 5 ft 8 in tall, 265 lbs
- “sees red” OD
- Type 2 DM x 3 yrs
- Recent Dx. Obstructive Sleep Apnea

A Global Epidemic……

1 in 3 children born today will develop diabetes in their life

50% of the global diabetes population is undiagnosed

Up to 50% of diabetes is detected because of a clinical complication (e.g. retinopathy, nephropathy)

The Future

Diabetes => a 2-4 fold increased risk of CV disease

Leading Causes of Death in 2010

1. Heart disease: 597,689
2. Cancer: 574,743
3. Chronic lower respiratory diseases: 138,080
4. Stroke (cerebrovascular diseases): 129,476
5. Accidents (unintentional injuries): 120,859
6. Alzheimer’s disease: 83,494
7. Diabetes: 69,071
8. Nephritis, nephrotic syndrome: 50,476
9. Influenza and Pneumonia: 50,097
10. Intentional self-harm (suicide): 38,364

Prevalence of Diabetic Retinopathy

- Hispanic population has highest overall prevalence rate of Diabetic Retinopathy
- African-Americans tend to have highest rates of sight-threatening Diabetic Retinopathy
- No prominent difference between genders in prevalence of Diabetic Retinopathy
- Higher prevalence of DR in older age groups

Screening for Diabetes & Pre-Diabetes

- Consider testing if person is:
  - Overweight or obese with additional risk factor for diabetes
  - Age 45 or older
- Obtain: A1C or FPG or 2-hour plasma glucose post 75g OGTT
- Repeat testing every 3 years if results are normal
- In patients with increased risk, identify and treat other CVD risk factors

**Diagnostic Criteria for Pre-Diabetes & Diabetes**

<table>
<thead>
<tr>
<th></th>
<th>A1C</th>
<th>Fasting Plasma Glucose Test (FPG)</th>
<th>2-Hour Oral Glucose Challenge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acceptable</td>
<td>≤5.6%</td>
<td>Below 100 mg/dl</td>
<td>Below 140 mg/dl</td>
</tr>
<tr>
<td>Pre-Diabetes</td>
<td>5.7% - 6.4%</td>
<td>100-125 mg/dl (IFG)</td>
<td>140-199 mg/dl (IGT)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>≥6.5%</td>
<td>126 mg/dl or above</td>
<td>200 mg/dl or above</td>
</tr>
</tbody>
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**Diabetes is a disease of impaired insulin action**

- Decreased insulin production
- Resistance to insulin action

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**Diabetes**

- M____________ S________ characterized by central (abdominal) obesity, dyslipidemia, raised blood pressure, and insulin resistance.
- “Diabesity”
  - Up to 97% of type 2 caused by excessive weight

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**Diabesity**

- Obesity
- Dyslipidemia
- ↑ Blood Pressure
- Diabetes

**Metabolic Syndrome**

- *3 or more are diagnostic of Metabolic Syndrome:
  - waist circumference:
    - Men — > 40 inches
    - Women — > 35 inches
  - triglycerides ≥150 mg/dL
  - HDL cholesterol:
    - Men — <40 mg/dL
    - Women — <50 mg/dL
  - BP ≥130/85 mmHg
  - FPG ≥100 mg/dL

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**Diabetes is Inflammation**

- Leukocytes, once inside retinal tissue, secrete a variety of inflammatory substances such as TNF and VEGF.
- These released mediators increase vascular permeability and stimulate more mediators to enhance the inflammatory reaction.
QUESTIONS
AND COMMENTS?

Non-Proliferative Diabetic Retinopathy

Diabetic Macular Edema
Diabetic Papillopathy

Fibrous proliferation
NVD
Preretinal hemorrhage
The Importance of Macular Pigments

- Serum levels of lutein and zeaxanthin are inversely associated with type 2 DM and impaired glucose metabolism.
- A recent study showed that type 2 patients—with or without retinopathy—had reduced MPOD compared to non-diabetic patients. In addition, researchers observed an inverse correlation between MPOD and HbA1c levels.

Crystalline Lens Autofluorescence (CLA)

- CLA identifies elevated advanced glycosolated end-products (AGEs)—a biomarker highly correlated to glycemic status—prior to the presentation of early-stage complications of DM.
- Subjects with poor long-term glycemic control had significantly higher levels of lens AGEs compared to age-matched healthy controls.

CLA with ClearPath DS-120

Google Glucose Smart CL

Important systemic effects of DM and associated conditions that modify DR and/or increase risk of other end organ damage.

Important Factors in DM/DR

1. Glycemic Control
   - Hb A1C under 7% (ADA), (AACE <6.5%)
   - Can be higher in patients with CVD, hypoglycemia, shorter life expectancy and children (7%-8%)
   - ACCORD vs. ADVANCE studies

2. Hypertension
   - Patients with diabetes need a BP of 125/80 or better

3. Dyslipidemia
   - Target LDL cholesterol level for men and women with diabetes is <100mg/dL.
   - For HDL, the target is >40mg/dL for men and >50mg/dL for women.
   - Triglycerides < 150 mg/dl

4. Sleep Apnea needs to be ruled out/treated
   - CPAP - reduces nocturnal hypertension, increases oxygen, decreases FBS

Even small reductions in A1C levels significantly reduce the risk for long-term complications.
UKPDS: 1% A1C Decrease & Reduced Risk of Complications

The UK Prospective Diabetes Study (UKPDS)

Hypertension

The Eye in Systemic Disease

54 year old
+ Diabetes
+ HTN
+ Cholesterol

Important Factors in DM/DR

#5. Anemia needs to be ruled out/treated
  - Hemoglobin needs to be above 11
  - Procrit (E-poetin alfa) needs to be considered if Hb below 9
  - Starts early, has negative impact on CV morbidity, mortality

#6. Kidney Disease
  - Proteinuria (albuminuria) – Starlings Law (hydrostatic vs. osmotic pressure)
    - 30-299 mg = microalbuminuria
    - 300 mg or more = albuminuria
    - ADA recommends yearly urinalysis followed by GFR
    - Start ACE inhibitors = reno-protective

#7. Obesity
  - BMI (body mass index) less than 30 ... better if less than 25
    - AACE recommends bariatric surgery for type 2 patients with BMI > to 35 kg/m2.
    - Stressed if other conditions are present (PTC, OSA, hypertension, heart disease).

Diabetic Nephropathy

Hydrostatic Pressure = fluid out
Osmotic Pressure = fluid in
Obesity Trends* Among U.S. Adults
BRFSS, 1994

Obesity Trends* Among U.S. Adults
BRFSS, 2009

Obesity trends-2012

“Diabesity Belt”
Age-Adjusted Prevalence of Diagnosed Diabetes
Among U.S. Adults
2010

The Pathology of Obesity

Ocular Complications of Excess Weight
The Eye in Obstructive Sleep Apnea Syndrome (OSA)
Systemic Complications of OSA

- HTN
- Type 2 DM
- Congestive Heart Failure
- Coronary Artery Disease
- Atrial Fibrillation
- OSA is an independent RF for stroke.*

Ocular Complications of OSA

- Changes in eyelid tissue
  - Floppy eyelid syndrome (FES)
- Changes in cornea
  - K-conus
- Changes in the optic nerve
  - The glaucomas
    - open angle (OAG)
    - normal tension (NTG)
  - Non-arteritic anterior ischemic optic neuropathy (NAION)

CPAP: “Up your nose with a rubber hose!”

CPAP Therapy

Important Factors in DM/DR

#8. Smoking
- Increases proteinuria, BV wall damage, vasoconstriction

#9. Vasculitis
- Rule out gum disease, gastritis, UTIs, leg ulcers, etc.
- Daily aspirin decreases CVD in types 1 and 2
- ASA 81–325 mg /day
  - Not studied extensively for patients under the age of 30
  - CRP of 3.0 mg /L or higher can triple risk of heart disease
  - CRP of 0.5 mg /L or less rarely experience heart attacks

#10. Vitamin D deficiency
- African Americans that live in the north have low levels
Cigarette Smoking, Ocular & Vascular Disease

- Increased arteriolar stiffness (sclerosis)
- Increased Vascular Endothelial Growth Factor (VEGF) production
- Development/worsening of DR
- Development/worsening of AMD

DM + Smoking = Blindness

Did You Know...

Oral Health = Overall Health

- For people aged one to 70 years, the RDA is 600 IU.
- For people over 70, RDA is 800 IU

<table>
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<tr>
<th>Serum 25-Hydroxyvitamin D (25(OH)D) Concentrations and Health</th>
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<tbody>
<tr>
<td>&lt;12ng/mL</td>
</tr>
<tr>
<td>12-20ng/mL</td>
</tr>
<tr>
<td>&gt;20ng/mL</td>
</tr>
<tr>
<td>&gt;300ng/mL</td>
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</tbody>
</table>

Sources of Vitamin D

- Non-fat fortified milk: 1 cup per day
- Fish: salmon, tuna, sardines, mackerel, herring: at least three servings per week
- “Sensible sunlight”: Five to 15 minutes, two to five times per week
- Vitamin D3 supplements: 1,000 IU per day

THE VITAMIN D DEFICIENCY EPIDEMIC

Winter Influenza
Winter Depression
Rickets (Children)
Osteoporosis
Autoimmune Disease
Organ Transplant Rejection
Low Vitamin D
Hypertension
Winter Depression
Breast, Prostate, Uterine, Colon

Dietary Vitamin D:
Cod Liver Oil, Sockeye Salmon

- Modulation of cell growth
- Neuromuscular and immune function
- Reduction of inflammation*
- Vitamin D may moderate cardiac and vascular disease, and reduce proteinuria.
Important Factors in DM/DR

11. Insufficient Sleep
- Increase in blood insulin and inflammation
- Sleep loss / decreased sleep quality => obesity, DM
- Short sleep (< 7 hours) increasing in Blacks, Hispanics
- Sleep deprivation = Decreased leptin, increased ghrelin
- Decreased physical activity
- Increased cortisol release and insulin sensitivity
- Melatonin’s role in diabetes?

12. Chronic Stress –
- Leads to change in gene expression, cellular aging
- Increase in cortisol, insulin, inflammation
- Cortisol increases cytokines, oxidative stress
- Telomere shortening – insulin resistance
- Prefrontal cortex overcome by limbic lobe and NA
- Stress and junk food = increase in visceral fat

#13. Neuropathy
- Microvascular complication (like DR, DNeph)
- Recognize the risk factors, symptoms (numbness, tingling), signs (reduced reflexes, poor nerve conduction).

#14. Vitamin B-12 Deficiency
- Metformin induced

MACROVASCULAR COMPLICATIONS
- Coronary artery disease
  - Heart attacks
- Peripheral vascular disease
  - Limb Amputations
- Cerebral vascular disease
  - Strokes
- Renal vascular disease
  - Renal failure and dialysis

Medical Nutrition Therapy
ADA Guidelines = dietary caloric intake
Low carbohydrate (50%)
- reduces post-prandial hyperglycemia
Low fat (30%)
- (eliminate trans fat, reduce saturated fat intake)
Low protein (20%)
Increase dietary fiber = DCCT decrease DR progression
10-30 gram / day, US = 12 gram
MNT lowers Hb A1C ~ 1%
Omega-3s (EPA and DHA)
- Decreases insulin resistance
- Decrease depression
- Prevents cardiac arrhythmias
- Increases telomere length
- 1000 mg to 4000 mg / daily

USDA replaces the food pyramid

Conclusions

Take Home Message on DM/DR
- Diabetic Retinopathy is exacerbated by many concomitant conditions.
- Control of the systemic aspects of the disease improves both systemic and ocular health.
- Understand how Diabetic Retinopathy relates to the overall systemic health.

Thank you!

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