

# Metabolic Conditions

*Diabetes Mellitus, Obesity, &  
Metabolic Syndrome*

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# Outline

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  - » FITT guidelines
  - » Risks & complications: modifying the FITT prescription
  - » Case study
- Metabolic Syndrome
  - » Brief overview of disease
  - » Clinical management
  - » Exercise considerations



# Diabetes Mellitus (DM)

- *Type I*
  - » ~10% of DM cases
  - » Beta cell destruction by autoimmune processes that leads to insulin insufficiency
- *Type II*
  - » ~90% of DM cases
  - » Varying degrees of insulin resistance & relative insulin deficiency
- *Gestational Diabetes:*
  - » Any degree of glucose intolerance with onset or 1st recognition during pregnancy



# Diabetes Facts

- NOW: affects >2 million Canadians
- 2010: expected to rise to 3 million.
  
- Prevalence of Type 2 diabetes is increasing due to:
  - » aging population
  - » increase in **obesity rates** and **sedentary lifestyles**
  
- Ethnic factors:
  - » Aboriginal people are 3-5 X's more likely than the general population to develop type 2 diabetes.
  - » 77% of new Canadians come from populations that are at higher risk for type 2 diabetes (i.e., Hispanics, Asians, South Asians or those of African descent).



# Measurement of Blood Glucose

## Units for blood glucose (BGL) measurement:

- »  $\text{mmol}\cdot\text{L}^{-1}$  (world standard);  $\text{mg}\cdot\text{dL}^{-1}$  is US or traditional standard
- » To convert  $\text{mmol}\cdot\text{L}^{-1}$  of glucose to  $\text{mg}\cdot\text{dL}^{-1}$ : multiply # by 18.

## Recommended BGL for Diabetics:

- » Fasting:  $4.0 - 7.0 \text{ mmol}\cdot\text{L}^{-1}$
- » 2 hrs after eating:  $5.0 - 10.0 \text{ mmol}\cdot\text{L}^{-1}$
- ⇒ Exercise contraindicated if  $<4.0 \text{ mmol}\cdot\text{L}^{-1}$  or  $> 16 \text{ mmol}\cdot\text{L}^{-1}$

## A1c test:

- » Estimation of average glucose in the blood over last 1-2 months
- » 1% change in A1c =  $\sim 1.67 \text{ mmol}\cdot\text{L}^{-1}$  change in average blood glucose.
- » Recommended A1c for diabetics = 6%

*Slide courtesy of Cheryl Govenlock*



# Clinical Management of DM

- Management depends on form of diabetes, blood glucose goals, and presence/severity of diabetic complications
- Management often involves
  - » Medications to normalize blood glucose including insulin, oral hypoglycemic agents (for Type II) or both
    - ⇒ Some medications may cause hypoglycemia. Know how to treat.
    - ⇒ Usually precipitated by insufficient food to cover glucose lowering effect of drug and/or more exercise than usual
  - » Lifestyle interventions
    - Individualized nutrition care plan
    - Regular exercise, as appropriate
    - Reduce risk of cardiovascular disease



# Rationale for Using Exercise in Management of DM

- Possible improvement in blood glucose control in Type II DM
- Improved insulin sensitivity/lower med. requirement
- Reduced body fat
- Reduced risk of cardiovascular disease
- Stress reduction
- Reduced risk of type II DM in those with impaired glucose tolerance, gestational diabetes, or family history of DM



# Precautions to take with DM Clients

- *Know warning signs of hypoglycemia. Know how to treat.*
  - » Hungry, shaky, nervous, tachycardia, etc.
  
- *Have CHO-based foods readily available*
  - » 3/4 cup of juice or regular pop
  - » 3 teaspoons of sugar dissolved in water
  - » 6 Life Savers (1 = 2.5 g of carbs)
  
- *Monitor blood glucose before and after exercise*
  - » Client should monitor their glycemic response to different types of exercise
  - » Delay exercise if hyperglycemic ( $>16 \text{ mmol}\cdot\text{L}^{-1}$ )
  - » Ingest added CHO if hypoglycemic ( $<4 \text{ mmol}\cdot\text{L}^{-1}$ )
  - » Avoid exercising late at night
  
- *Expect low initial fitness level*



# Exercise Testing

- Graded exercise test (GXT) for DM patients at high risk for vascular disease based on one of the following criteria:
  - » age > 35 years
  - » type 2 diabetes of >10 years duration
  - » type 1 diabetes of >15 years duration
  - » presence of any additional risk factor for coronary artery disease
  - » presence of microvascular disease (retinopathy or nephropathy, including microalbuminuria)
  - » peripheral vascular disease
  - » autonomic neuropathy

*ADA/ACSM Joint Position Stand 1997*



# Exercise Testing Considerations

- *Prescreening*
  - » Thorough physical exam is recommended
  - » Health history questionnaire essential
- *Body composition*
  - » Weight management is likely an issue!
- *Aerobic fitness*
  - » Client will likely have numerous CVD risk factors
  - » Stress test recommended in diabetics >35 yrs
  - » Consider non-weight bearing modes for patient with neuropathies
- *Musculoskeletal fitness*
  - » Shown to enhance insulin action and improve blood glucose control
  - » Improves ability to perform activities of daily living. May increase confidence and facilitate adherence to exercise program.



# FITT Guidelines for Type I/II DM

- Aerobic
  - F: 4-7 days/wk
  - I: 50-90% peak HR & monitor RPE!
  - T: 20-60 min
  - T: enjoyable activities that involve large muscle groups
- Musculoskeletal Fitness
  - » As recommended for asymptomatic client
- Notes
  - ⇒ Avoid exercise at time of peak insulin reaction
  - ⇒ Modify FITT if complications such as neuropathy, retinopathy, etc. are present.
  - ⇒ Remember that certain medications or complications (autonomic neuropathy) may affect HR
  - ⇒ Establish routine for exercise



# Be Aware!

## Risks & Complications of DM

- Acute glycemic responses
  - » Increased risk for hypoglycemia with certain medications during *and up to 6 hrs post-exercise*
  - ⇒ Self blood glucose monitoring, CHO snacks readily available
- Vascular disease
  - ⇒ Use a risk stratification scheme (i.e., ACSM, Framingham) for testing/prescription
- **Autonomic neuropathy:** *group of symptoms caused by damage to nerves that regulate autonomic functions (i.e., BP, HR, etc.)*
  - ⇒ HR response to exercise will be affected. **MUST** use RPE!
  - ⇒ At risk for silent ischemia
  - ⇒ Focus on low-intensity activities of daily living



# Be Aware!

## Risks & Complications of DM (con't)

- **Peripheral neuropathy:** *related to the peripheral nervous system – generally a paresthesia*
  - May need to prescribe non-weight bearing activities
  - Ensure proper footwear
- **Nephropathy:** *inflammatory, degenerative or sclerotic condition of the kidneys*
  - Clients must be stable
  - Ensure adequate fluid replacement
  - Avoid activity which cause systolic BP to rise over 170 mmHg
- **Retinopathy:** *non-inflammatory disorder resulting from changes in the retinal blood vessels*
  - Low-intensity aerobic activity can be safely performed
  - Avoid activity which cause systolic BP to rise over 170 mmHg



# DM Case Study

- 54 year old male, employed in a boat building yard
- 10 yr history of Type II diabetes
- 5 yr history of hypertension
- 1 yr history of hypercholesteremia
- Father died at age 42 of MI
- Blood sugar control: fasted blood sugar is 8.4 mmol·L<sup>-1</sup>, A1C: 7.6%
- No graded exercise test (GXT) performed
- GP referred client to improve blood sugar control
- Medications: Metformin & Glyburide (oral hypoglycemic agents), ASA (blood thinner), Altace (ACE inhibitor), Lipitor (statin)
- Exercise History: none – feels his job is physical enough
- Body Composition: BMI 34, WG: 110
- Reports previous low back injury but otherwise feeling well

*Slide courtesy of Nancy Payne*



# Considerations

## ➔ *High risk for CVD*

- » ACSM risk stratification: >45 yrs, diabetic, hypertension, obesity, family history, hypercholestermia → *prescribe low to moderate intensity exercise only in absence of GXT*

## ➔ *No GXT*

- » GP cleared client for exercise

## ➔ *Poor blood sugar control*

- » Fasted blood sugar is 8.4 mmol·L<sup>-1</sup> (normal = <5.0 mmol·L<sup>-1</sup>)
- » Asymptomatic – no signs/symptoms of neuropathies or kidney problems

## ➔ *MSK issues*

- » Lower back

## ➔ *Medications*

- » MEDLINE DRUG INFO: [www.nlm.nih.gov/medlineplus/druginformation.html](http://www.nlm.nih.gov/medlineplus/druginformation.html)



# Considerations (con't)

- ➔ *Goal of exercise program*
  - » Improve glucose metabolism. Reduce CVD risk factors. Weight loss
  
- ➔ *Review signs & symptoms of hypoglycemia. Know how to treat.*
  - » Exercise contraindicated if  $<4.0 \text{ mmol}\cdot\text{L}^{-1}$  or  $> 16 \text{ mmol}\cdot\text{L}^{-1}$
  - » Exercise 1-2 hrs after medication/food
  - » 15 grams CHO may be needed if  $> 3$  hrs after meal
  - » Test pre & post exercise blood sugar levels to establish response
  
- ➔ *Client is at risk of silent ischemia!*
  - » Rely on RPE and shortness of breath on exertion as signs of CVD progression
  
- ➔ *Exercise program considerations*
  - » “Moderate” risk suggests low to moderate intensity exercise only
  - » Refer back to GP when ready for more vigorous exercise



# Exercise Prescription

## *Aerobic Prescription (ACSM guidelines)*

- F: 3-5 sessions/week, encourage daily activity to maximize kcal expended
- I: 60-70% max HR to start + RPE (3-4 / 10 Borg scale)  
Request GXT when ready to progress to more vigorous exercise
- T: Start with 20 minutes. Progress to 60 minutes.
- T: Have client select enjoyable activities that use large muscle groups

*Progression:* focus on time, modify every 2-3 weeks

## *Resistance Training:*

- » 2-3 /week, 8-12 reps, 1-2 sets of 8-10 exercises covering major muscle groups.
- » Ensure good technique to minimize injury to lower back. Demonstrate proper lifting techniques for when client is at work.

## *Flexibility*

- » CPAFLA guidelines

# Obesity





# Defining Obesity

## Health Canada Guidelines

| BMI Value   | Classification  | Health Risk    |
|-------------|-----------------|----------------|
| <18.5       | Underweight     | Increased      |
| 18.5 - 24.9 | Normal weight   | Least          |
| 25.0 - 29.9 | Overweight      | Increased      |
| 30.0 - 34.9 | Obese class I   | High           |
| 35.0 - 39.9 | Obese class II  | Very high      |
| ≥ 40        | Obese class III | Extremely high |



# Health Risks of Obesity

- being overweight or obese is a known risk factor for:
  - » cardiovascular disease
  - » hypertension
  - » type 2 diabetes
  - » dyslipidemia
  - » gallbladder disease
  - » certain types of cancer
  - » musculoskeletal disorders
- ↑ risk of morbidity, mortality, premature death
- ↓ quality of life



# Weight Loss Recommendations

- indicated for individuals with...
  - » BMI  $\geq$  25 kg-m<sup>2</sup>
  - » and/or: waist girth: males  $\geq$  102 cm; females  $\geq$  88 cm
- even modest reductions in body weight (5-10%) will significantly improve health
  - » do not need to be at optimal weight to achieve health benefits



# Weight Loss Programs

- Obesity is a complex interaction of physiological, behavioral, psychological, genetic, cultural and social factors
- Weight loss and management programs must consider:
  - » diet
  - » exercise
  - » *behavioral interventions*, support groups



# Dietary Considerations

- number, timing, location of meals and snacks
- number of meals eaten/prepared outside of the home
- reasons people eat
  - » hunger, boredom, habit, emotions - very happy or very sad, food as a reward, holidays
- social and cultural context
  - » “clean off your plate”, “don’t waste food”, “don’t refuse food”



# Benefits of Exercise in Weight Control

- exercise expends energy (calories)
- reduces the morbidity and mortality associated with obesity
  - » affects BP, lipids, cholesterol and CV fitness
- may suppress appetite
- improves psychological function
  - » reduce anxiety, depression, improve general mood, self-concept
- may help replace eating as a habit



# Incorporating Exercise into Weight Loss Programs

- ➔ Be sensitive to excess weight
  - » Consider self-image and body-image concerns
  - » Identify barriers; identify previous experience with physical activity
  
- ➔ Emphasize psychological benefits
  - » Improved mood, self-image, sense of accomplishment and achievement
  
- ➔ Set personal, achievable, and objective goals
  - » Track and reward success of incorporating physical activity
  
- ➔ Do not set a threshold for exercise
  - » Emphasize consistency in physical activity; encourage variety



# Exercise Testing

- *Body composition*
  - » Use discretion. Healthy body composition using CPAFLA can be determined with BMI and/or waist girth alone.
  - » Skinfolds may be inaccurate if BMI > 30
- *Aerobic fitness*
  - » Use risk stratification scheme for exercise testing/prescription guidelines. Consider risk of CVD.
- *Musculoskeletal fitness*
  - » Being able to complete activities of daily living may facilitate adoption of a more active lifestyle
  - » Maintains lean muscle mass



# Exercise Prescription

- **AEROBIC**

F: 5-7 days/wk

I: 55-70% HRmax or  $>1000 \text{ kcal}\cdot\text{wk}^{-1}$  (70-85% can be tolerated in those with minimal risk of injury)

T: 20-60 minutes/day (multiple sessions?)

T: large muscle activities, activities of daily living

- **Notes:**

- » Incorporate behavioural intervention strategies

- » Emphasize duration vs. intensity

- » Consider referring to dietician, psychotherapist

- » Equipment modification may be necessary

- » For long-term weight loss  $\rightarrow$  200-300 min/wk of activity or  $>2000 \text{ kcal/wk}$



# Special Considerations

- *Increased risk of orthopedic injury*
  - ➔ Consider mode of exercise, intensity, and duration. Be conservative in beginning of program.
- *Increased risk of cardiovascular disease*
  - ➔ Use ACSM risk stratification to guide exercise testing/prescription.
  - ➔ Likely on medications...know side effects.
- *Increased risk of heat tolerance*
  - ➔ Advise client to wear loose comfortable clothing.
  - ➔ Ensure well ventilated room. Use fans.
- *Risks of other diseases (CVD, diabetes, etc.)*
  - ➔ How will other diseases affect exercise response?
- *Equipment*
  - ➔ May need specialized equipment.



# Case Study

- Gigi, 54 yrs, administration assistant, low self-esteem
- Overweight for 37 yrs. History of yo-yo dieting
- Wants to lose weight, feel better, enjoy her grandson
- Hospitalized for depression 4 yrs ago. Continues psychotherapy
- Family history: mom had MI, hypertension, and diabetes
- Social history: bridge 1x/wk
- BMI - 50.5; resting HR - 85 bpm; BP - 138/88 mmHg (on anti-hypertensive medication)
- High blood cholesterol
- Poor eating habits
- Low aerobic capacity
- Exaggerated BP response to exercise test
- Not in acute distress
- Sedentary
- Medications: Prozac, Lipitor, Altace, Aspirin

# Metabolic Syndrome

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# Metabolic Syndrome

- A group of metabolic risk factors in one person
  - » **Abdominal obesity**
  - » **Insulin resistance or glucose intolerance**
  - » Blood fat disorders (i.e., high triglycerides, low HDL cholesterol and high LDL cholesterol)
  - » Elevated blood pressure
  - » Prothrombotic state
  - » Proinflammatory state
- *Those with metabolic syndrome are at increased risk of cardiovascular disease and type 2 diabetes.*



# Clinical Management

- Reduce the risk for cardiovascular disease and type 2 diabetes.
- Lifestyle interventions include:
  - » *Weight loss*: BMI < 25 kg·m<sup>-2</sup>
  - » *Increased physical activity*: 30 min of moderate-intensity activity on most days of the week
  - » *Healthy eating habits*: i.e., reduced intake of saturated fat, trans fat and cholesterol



# Exercise Considerations

- Use *ACSM risk stratification* to guide exercise testing & prescription
- Ensure *blood glucose is stable*.
  - » Review DM exercise testing/prescription notes.
- *Healthy weight loss*
  - » Insulin sensitivity improves within a few days of caloric restriction, before any significant weight loss occurs.
- *Resistance training*
  - » A gain in lean muscle mass may increase sensitivity of the cells to glucose uptake.