ENDOCRINE SYSTEM
Located in the retroperitoneal space of the upper abdomen, behind the stomach
Anatomy & Physiology

- Closely attached to other retroperitoneal structures
  - Ganglia and nerves of the celiac plexus
- Has an exocrine and endocrine portion
  - Exocrine — secretes (main source) digestive enzymes
    - Those that break down starch, lipids, proteins
  - Endocrine — secretes hormones
    - Insulin, glucagon, somatostatin
Physiology

- Alpha cells secrete glucagon (20%)
  - Increases BG levels by stimulating liver and other cells to release stored glucose
- Beta cells secrete insulin (70%)
  - Lowers BG levels by facilitating entrance of glucose into the cells for metabolism
- Delta cells secrete somatostatin (10%)
  - Believed to regulate release of insulin and glucagon
Major Diseases
Acute Pancreatitis

- Tissue necrosis caused by digestive enzymes being released and activated prematurely
  - Accompanied by edema and hemorrhage

- Etiology
  - Medications
  - Viral infections
  - Pancreatic surgery
Acute Pancreatitis

- Clinical Manifestations
  - Peritonitis
    - Caused by leakage of digestive enzymes into abdominal cavity
  - Pseudocyst and abscess formation
    - Capsule of both structures becomes fibrotic with time
  - Progression to chronic pancreatitis
  - Peritoneal rigidity
    - Accompanied by paralytic ileus
Acute Pancreatitis

- Clinical Features
  - Abdominal pain & distention
  - Nausea & vomiting
  - Anxiety
Acute Pancreatitis

- **Treatment**
  - Prevent damage and systemic consequences of shock
  - Eliminate cause of pancreatitis

- **Prognosis**
  - Can cause heart, lung, kidney failure and lead to death
  - 20% mortality rate
    - Consequence of shock
    - Mortality rate increases with older patients with multiple co-morbidities
Chronic Pancreatitis

- Fibrosis replaces pancreatic parenchyma
  - Irreversible, progressive
- Produce endocrine and exocrine pancreatic insufficiency
- Etiology/Pathogenesis
  - Related to alcohol abuse
  - Cystic fibrosis
  - Heredity
Chronic Pancreatitis

- Clinical Features
  - Pain
  - Malabsorption
    - Weight loss, weakness
  - Signs of DM
    - Destruction of islets of Langerhans
Pancreatic Cancer

- Risk factors thought to be:
  - Tobacco use
  - Previous intestinal surgery
  - DM
  - Chronic pancreatitis

- Poor prognosis
  - Incurable...detected too late
  - Clinically silent without warning signs
  - Metastases occur early in disease
Pancreatic Cancer

- Symptoms are non specific
  - Weight loss
  - Loss of appetite
  - Nausea
  - Vomiting
  - Jaundice
Diabetes Mellitus (DM)

- There are 23.6 million children and adults in the United States, or almost 8% of the population, who have diabetes.

- While an estimated 17.9 million have been diagnosed with diabetes, unfortunately, 5.7 million people (or nearly one quarter) are unaware that they have the disease.
Diabetes Mellitus

- Group of systemic, metabolic diseases characterized by chronic hyperglycemia
  - Resulting from defect in insulin secretion, insulin action or both
  - Causing disturbances in carbohydrates, protein, and fat metabolism

- Chronic hyperglycemia is associated with long-term damage, dysfunction, and failure of various organs
  - Eyes, kidney, nerves, heart and blood vessels
Diabetes Mellitus

- IDDM (Type I)
  - Pancreatic beta cell destruction, usually leading to absolute insulin deficiency
  - Etiology
    - Autoimmune
    - Viral
    - Genetic
    - Environmental
    - Idiopathic
Diabetes Mellitus

- IDDM (Type I)
  - Symptoms tend to occur suddenly
  - Individual usually
    - <20 y/o (onset)
    - Normal or thin
  - Treatment
    - Insulin
    - Diet
    - Exercise
Diabetes Mellitus

- NIDDM (Type II)
  - More prevalent form
  - Insulin produced, but the insulin produced is ineffective and resistant to action on a cellular level or the amount produced is not sufficient
  - Risk factors
    - Age
    - Obesity (and/or increased % age of central body fat distribution)
    - Lack of exercise
    - Genetics
Diabetes Mellitus

- NIDDM (Type II)
  - Symptoms tend to develop over a period of time
  - Individual usually
    - >40 y/o (onset)
    - Obese (80%)
  - Treatment
    - Oral hypoglycemic agents
    - Diet
    - Exercise
    - Weight control
    - Insulin
## Diabetes Mellitus

### Classification

<table>
<thead>
<tr>
<th>Stage</th>
<th>Fasting Blood Glucose</th>
<th>Oral Glucose Tolerance Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&lt;100mg/dL</td>
<td>&lt;139mg/dL</td>
</tr>
<tr>
<td>Pre-Diabetes</td>
<td>100-125mg/dL</td>
<td>140-199mg/dL</td>
</tr>
<tr>
<td>Diabetes</td>
<td>&gt;125mg/dL</td>
<td>&gt;200mg/dL</td>
</tr>
</tbody>
</table>
Diabetes Mellitus

- Cardinal signs of DM
  - Polyuria — excessive urination
  - Polydipsia — excessive thirst
  - Polyphagia — excessive hunger (type I only)
  - Weight loss (type I only)
  - Recurrent blurred vision
  - Ketonuria (type I only)
  - Weakness, fatigue, dizziness
  - Often asymptomatic
Diabetes Mellitus

- Hyperglycemia
  - Thirst
  - Polyuria and volume loss
  - Dehydration
  - Lethargy/confusion
  - Seizures
  - Coma
  - Blood glucose level >300 mg/dL
Diabetes Mellitus

- Hypoglycemia
  - Shakiness
  - Dizziness
  - Sweating
  - Hunger
  - Headache
  - Pale skin color
  - Sudden moodiness or behavior changes; irritability
  - Clumsy or jerky movements
  - Seizure
  - Difficulty paying attention, or confusion
  - Tingling sensations around the mouth
  - Blood glucose level <70mg/dL
Diabetic ketoacidosis (DKA)
- Occurs when there is too little insulin in the body
- Without insulin, cells cannot use glucose for energy
- Instead the body breaks down fat and muscle for energy
- In effect, ketones (fatty acids) are produced and enter bloodstream
- Cause metabolic acidosis because of ketone build-up
- Primarily in IDDM

- Can be first sign of diabetes!
- Life threatening!
Diabetes Mellitus

- Diabetic ketoacidosis (DKA)
  - Etiology – any condition that increases the insulin deficit in a person with diabetes
    - Not taking enough insulin under stressful conditions
    - Severe infection or illness
    - Dehydration
    - Alcohol abuse
    - Stroke
    - Renal failure
    - Combination of above
Diabetes Mellitus

- Thirst or a very dry mouth
- Frequent urination
- High blood glucose (sugar) levels
- High levels of ketones in the urine
- Constantly feeling tired

Diabetic ketoacidosis (DKA) (Type I only) – Symptoms:
- Dry or flushed skin
- Nausea, vomiting, or abdominal pain
- A hard time breathing (short, deep breaths)
- Fruity odor on breath
- A hard time paying attention, or confusion
Diabetes Mellitus – Lifetime Changes

- Atherosclerosis
  - Begins earlier and more extensive
  - Increased risk for CAD, MI, CVA, PVD
  - Due to the hyperglycemia and increased fat metabolism associated with type I
Diabetes Mellitus – Lifetime Changes

- **Infection**
  - Impaired wound healing and risk for infections
  - Impaired vision and peripheral neuropathy
    - Can’t see or feel developing wounds
    - Vascular diseases causes skin hypoxia, impaired healing
  - Increased blood glucose fosters bacterial growth
Diabetes Mellitus – Lifetime Changes

- Retinopathy
  - Vascular complication
  - May lead to blindness
Diabetes Mellitus – Lifetime Changes

- Nephropathy
  - Single most common cause of end-stage renal disease (ESRD)
  - Hardening and thickening of the kidneys, with eventual destruction of critical renal filtration structures
  - Permanent dialysis or renal transplantation
Diabetes Mellitus – Lifetime Changes

- Musculoskeletal problems
  - Stiffness and limited joint mobility
  - CTS
  - Adhesive capsulitis
  - Dupuytren’s contracture
  - Osteoporosis
  - Flexor tenosynovitis/trigger finger
Diabetes Mellitus – Lifetime Changes

- Peripheral neuropathy
  - Affects distal extremities
  - Tingling, burning, numbness
  - Complete loss of sensation may result in the feet
  - Predisposition to trauma and joint destruction
    - Charcot’s disease
  - “Stocking” or “glove” paresthesia
Diabetes Mellitus – Lifetime Changes

- Autonomic neuropathy
  - Affects nerves that innervate heart, lung, stomach, intestines, bladder, and reproductive organs
  - Tachycardia
  - Exercise intolerance
Diabetes Mellitus – Lifetime Changes

- Ulceration
  - Caused by improper glucose metabolism and diminished vascular perfusion
    - Skin is dry and inelastic
  - Repetitive stress on insensitive skin with increased pressure
    - Necrosis and skin breakdown
Diabetes Mellitus – Lifetime Changes

- **Amputations**
  - Common complication of arthrosclerosis, increased infection, peripheral neuropathy, ulcerations
  - Toes → limbs
Diabetes Mellitus – Treatment

- **IDDM**
  - Insulin administration
  - Dietary management
  - Insulin pump

- **NIDDM**
  - Diet
  - Exercise
  - Oral hypoglycemic drugs
  - Exercise
  - Insulin if no response to other medications
Diabetes Mellitus - Prognosis

- Depends on
  - Food
  - Medication
  - Activity

- Can be fatal, and is a major cause of morbidity even with medical management
Physical Therapy

Diabetes Mellitus
Considerations and Education

- Hypo or hyperglycemia
  - Provide carbohydrates in some form (fruit juice, honey, hard candy)
    - if hypo, will feel better, symptoms will improve...
    - if hyper and/or no change...
      - Take BGs
      - If unable, call 911
  - Unconscious? Call 911
Exercise

- Take into account complications present
- Poor ability to perform aerobic exercise if have autonomic neuropathy
  - Decreased max HR, increased resting heart rate
- Predisposition to dehydration
- Silent MI during exercise common
- Proper footwear
  - Especially those predisposed to ulcerations
- Educate in always carrying a snack and stay hydrated
Diabetes and Exercise

- Exercise tends to have the same affect as insulin
  - Lowers blood glucose

- Benefits
  - Cardiovascular function
  - Musculoskeletal function
  - Maximal $O_2$ uptake
  - Insulin sensitivity (decreased need, increased efficiency of use)
  - Lowers insulin requirements
  - Weight reduction
  - Stress reduction
  - Blood glucose control
Diabetes and Exercise

- Avoid
  - High-intensity activities
  - Resistive exercises or high impact aerobics because of risk of retinal damage
  - Exercise when BG >300mg/dL or <70mg/dL
  - Exercise at peak insulin times (ask the patient)
  - Exercise of extremity where insulin was given
  - Exercise late at night...may have a delayed hypoglycemic reaction can occur late at night
Diabetes and Exercise

Do

- Educate in proper footwear
- Train balance and vestibular systems secondary peripheral neuropathy
- Moderate intensity exercise at scheduled times during the day
- Rhythmic exercises
  - Walking, cycling
- Include a warm-up and cool-down