Overview of Carbohydrate Metabolism:

The importance of regulating blood glucose levels.
Glucose:
Obligate fuel for CNS & RBC’s

• CNS/Brain
  – Dependent on glucose as primary source of fuel
    • Uses ~120g glucose/day of total 160-200 g/d

• RBC
  – Dependent on glucose
  – Lack mitochondria
Regulation of blood glucose levels

**Insulin**

Anabolic in response to hyperglycemia

- **Liver**
  - Stimulates glycogen synthesis, glycolysis, and fatty acid synthesis

- **Muscle**
  - Stimulates glycogen synthesis

- **Adipose**
  - Stimulates lipoprotein lipase resulting in uptake of fatty acids from chylomicrons and VLDL
  - Stimulates glycolysis for glycerol phosphate synthesis (precursor to triglycerides)
Figure 9-1
Role in insulin in lowering blood glucose
Regulation of blood glucose levels

Glucagon

• Catabolic, in response to hypoglycemia
• Liver
  – Activates glycogen degradation, gluconeogenesis
• Adipose
  – Stimulates lipolysis and release of fatty acids
Figure 9-2
Role of glucagon in increasing blood glucose levels
Diabetes Mellitus

• A multi-organ catabolic response caused by insulin insufficiency
• Muscle
  – Protein catabolism for gluconeogenesis
• Adipose
  – Lipolysis for fatty acid release
• Liver
  – Ketogenesis from fatty acid oxidation
  – Gluconeogenesis from amino acids and glycerol
• Kidney
  – Ketonuria and cation excretion
    • Renal ammoniagenesis (NH₄⁺, cation excreted with KB)
Figure 9-3: Metabolic Consequences of Insulin Insufficiency. Both anabolic pathways (gluconeogenesis) and catabolic pathways (protein degradation, triglyceride hydrolysis, fatty acid oxidation, ketogenesis, and ammoniagenesis) are activated in the absence of insulin.
Glucose Toxicity

• Diabetic complications
• Glycosylation of Protein
  – Reaction of glucose to amino groups
  – May be related to pathologic changes in eye, peripheral nerves, kidneys
  – Glycosylated hemoglobin (HbA1c)
• Polyol formation
  – Sorbitol production from aldol reductase
  – Accumulation of sorbitol results in osmotic changes and cataracts in the lens