

# 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

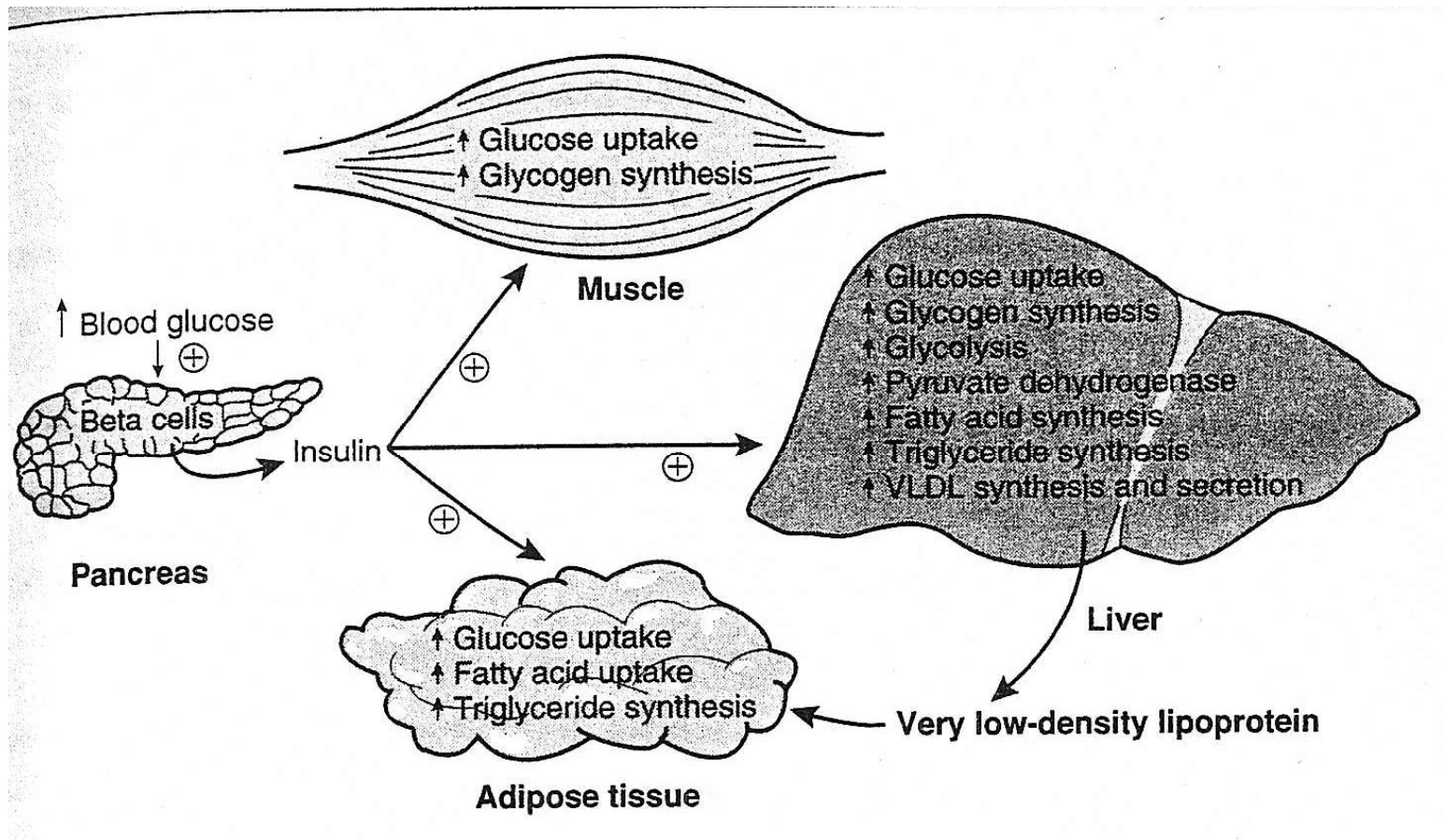
## Insulin

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



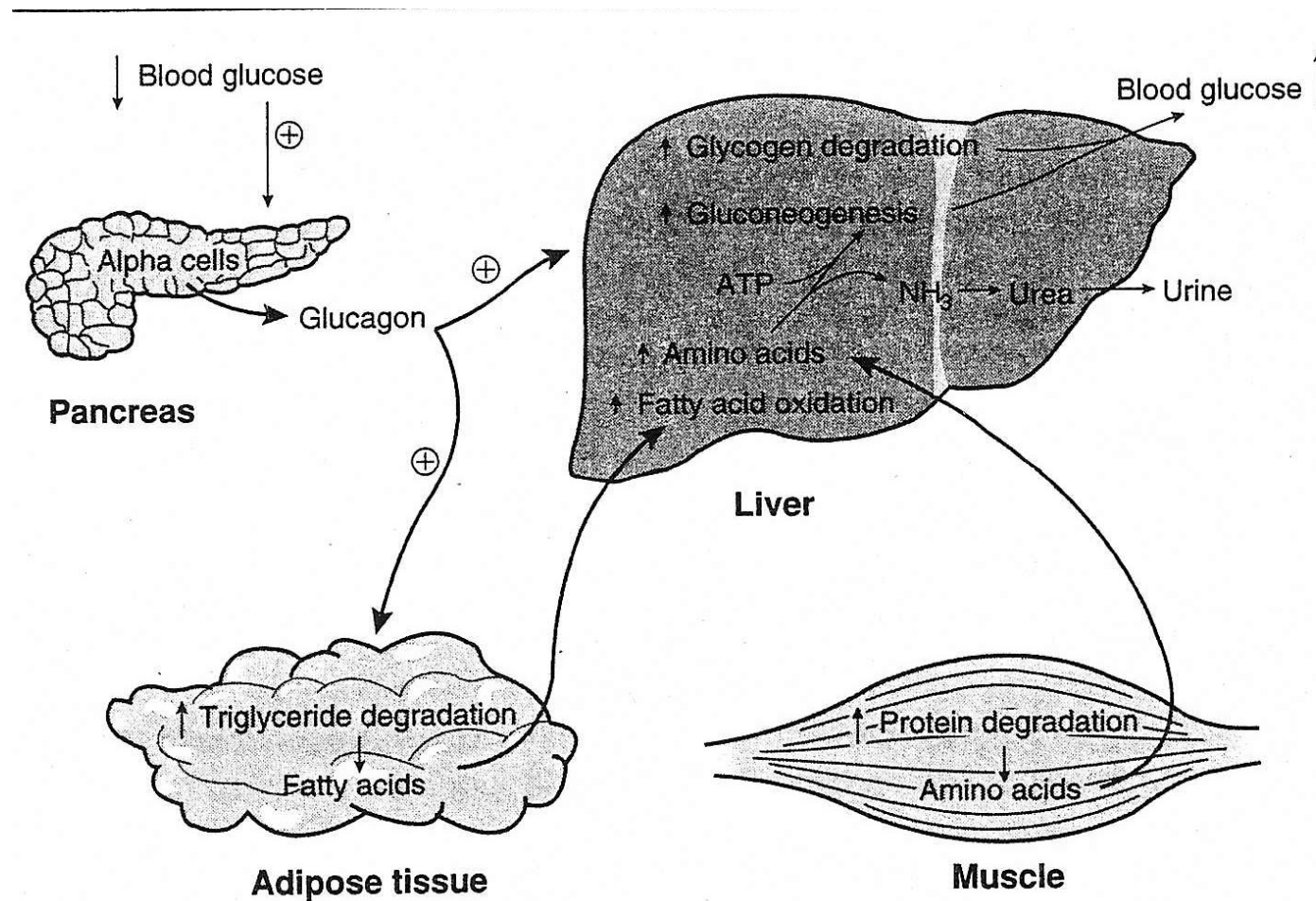
# Regulation of blood glucose levels

## Glucagon

- Catabolic, in response to hypoglycemia
- Liver
  - Activates glycogen degradation, gluconeogenesis
- Adipose
  - Stimulates lipolysis and release of fatty acids

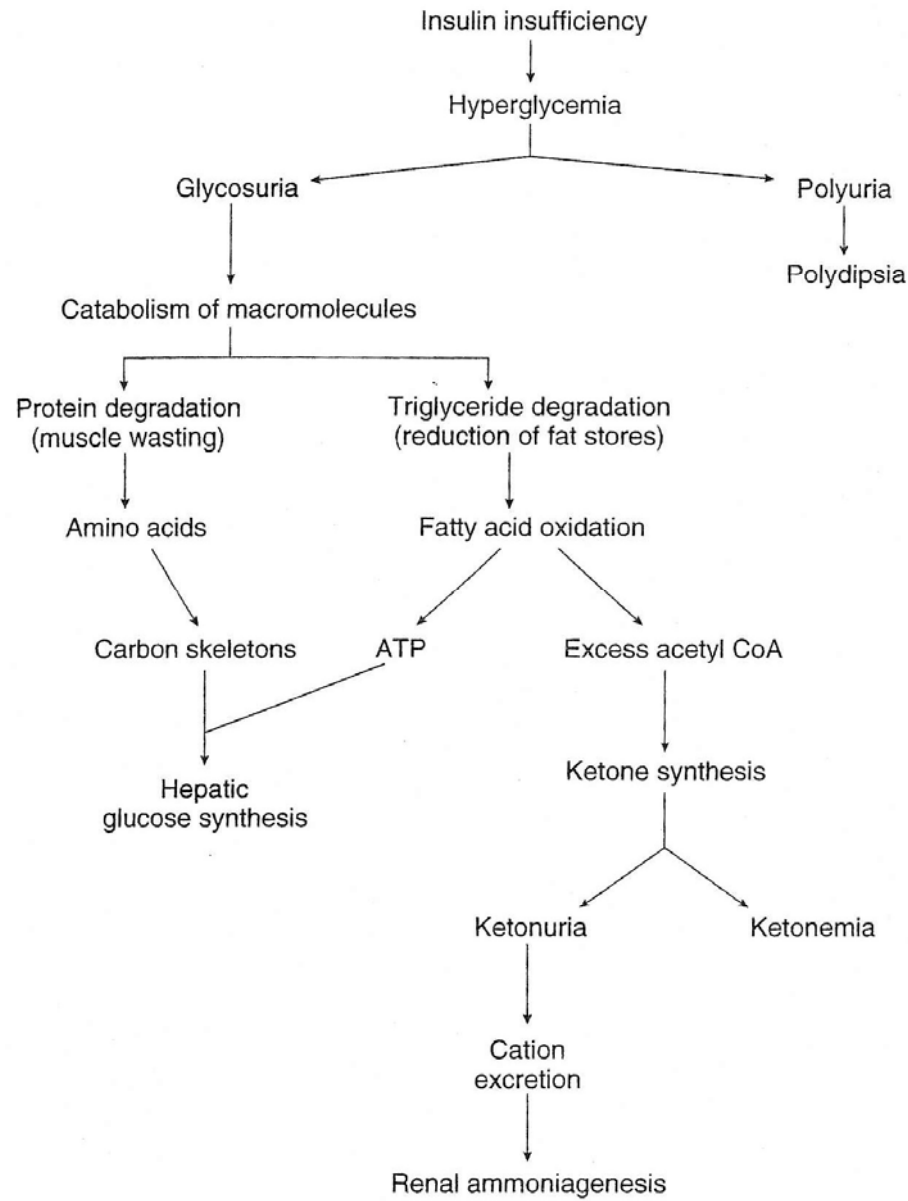
# Figure 9-2

## 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 ammoniogenesis ( $\text{NH}_4^+$ , cation excreted with  $\text{KB}$ )



**FIGURE 9-3**

**Metabolic Consequences of Insulin Insufficiency.** Both anabolic pathways (gluconeogenesis) and catabolic pathways (protein degradation, triglyceride hydrolysis, fatty acid oxidation, ketogenesis, and ammoniogenesis) 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