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# Hormonal Control

Monday, January 07, 2008  
10:00 AM

1. What are the overall effects of insulin and glucagon? How are blood levels of these hormones regulated? What cell types produce glucagons and insulin?
  - a. Insulin
    - i. Decreases blood sugar by
      - 1) Promotes uptake of glucose into muscle and adipose tissue by activating GLUT transporters
      - 2) Promotes storage of glucose --> glycogen, glucose --> FA and FA --> triglycerides
      - 3) Inhibits secretion of glucagon and transcription of glucagon gene
    - ii. Insulin levels increase w/ increased blood sugar
    - iii. Produced by beta/B-cells of pancreas in Islets of Langerhans
  - b. Glucagon
    - i. Promotes conversion of glycogen to glucose, gluconeogenesis, release of FA from adipose and FA oxidation
    - ii. Levels increase w/ decreased blood sugar and epinephrine stimulation
    - iii. Produced by A-cells of pancreas
2. What is the mechanism for the action of glucagons on metabolism?
  - a. Glucagon triggers the synthesis of cAMP by binding to a receptor on liver and adipose cell membranes
    - i. This g-protein coupled receptor causes GTP hydrolysis which activates adenylyl cyclase
    - ii. Adenylyl cyclase converts ATP --> cAMP
    - iii. cAMP can activate PKA via binding to the regulatory subunit and releasing the catalytic subunits
    - iv. PKA will then phosphorylate certain proteins
    - v. This phosphorylation can be activating or deactivating
  - b. Epinephrine follow a similar pattern in muscle, liver and adipose
3. How are the levels of cAMP regulated?
  - a. cAMP levels are regulated by the above mechanism (increases cAMP) as well as cAMP phosphodiesterase (PDE) (decreases cAMP)
  - b. PDE causes the conversion of cAMP to AMP
  - c. PDE is activated by PKA (feed-forward regulation) and by the insulin activated kinase
  - d. Thus, insulin leads to a decrease in cAMP levels and decreased PKA activity
4. What are the structured features of phosphoprotein phosphatase?
5. How is phosphoprotein phosphatase activity regulated?
  - a. Structure of PPP: constant catalytic subunit and variable regulatory subunit that regulates activity and cell location
  - b. Regulation of PPP: phosphorylation of the regulatory subunit
    - i. Liver PPP acts on proteins that are phosphorylated on serine or threonine
    - ii. PPP is activated by phosphorylation by insulin activated kinase by a huge cascade of reactions --> amplification
    - iii. PPP causes dephosphorylation of the protein
    - iv. There is also a PPP inhibitor
      - 1) PPI is activated by phosphoryation by PKA (cAMP)
      - 2) PPI binds to PPP to inhibit its activity
      - 3) PPI causes cAMP signal to remain ON