Regulation of Blood Glucose

DEFINITION

Blood sugar regulation is the process by which the levels of blood sugar, primarily glucose, are maintained by the body within physiological limits

A balance between two sets of factors:

A. Rate of Glucose entrance into blood stream

B. Rate of removal from blood stream

Normal values

- Fasting blood glucose: blood glucose levels after 10-12 hours of fasting is called fasting blood glucose
- It is usually estimated early in the morning after overnight fast
- Normal value: 70-110 mg/dl

- Post prandial blood glucose: test done 2 hours after a good meal is called post prandial blood glucose
- Normal value: < 140mg/dl

Factors which increase blood glucose

- absorption from intestine.
- glycogenolysis.
- gluconeogenesis.

Factors which decrease blood glucose.

- utilization of glucose by tissues.
- glycogen synthesis.
- conversion of glucose to fat.

- In regulation of blood glucose

- Liver
- Extrahepatic tissues
- Hormones

play an important role.

How the blood glucose is regulated?

- The regulation of blood glucose can be divided into two phases:
- 1. Absorptive phase: this is the state 2-4 hours after ingestion of normal meals

- During this phase there is ↑ in blood glucose
- This triggers release of insulin form islet cells of pancreas
- There is increase in amino acids and Triglyceride levels in blood

Liver

- During absorptive phase liver takes up glucose

- Excess glucose enters hepatocyte as Glu-6-P, used for glycogenesis and glycolysis

Other tissues

- During absorptive phase all tissues utilize glucose as source of energy

- The adipose tissue stores fat
- Muscles also store excess glucose as glycogen

These processes are activated by insulin

Post absorptive phase: fasting phase

- This is the phase after absorptive phase when no food is ingested
- Can occur during surgery, trauma, desire to lose weight, inability to obtain food, fasting

- There is decrease in blood glucose , amino acids and Triglyceride levels
- Glucagon is secreted by alpha cells of pancreas
- ↓ in insulin

Liver in starvation

- Several hours after meal, blood glc. ↓
- ↑ Glucagon secretion, ↓ release of insulin
- ↑ glucagon → rapid mobilization of liver glycogen stores.
- Liver glycogen exhausted after 10-18 hours of fasting.
- Most imp. function of liver is to

  - **synthesize glucose & release into circulation - GLUCONEOGENESIS**

- **Gluconeogenesis begins 4-6 hrs after the last meal, becomes fully active as liver glycogen stores get depleted.**
- IN PROLONGED FASTING, GLUCONEOGENESIS MAINTAINS BLOOD SUGAR LEVEL.

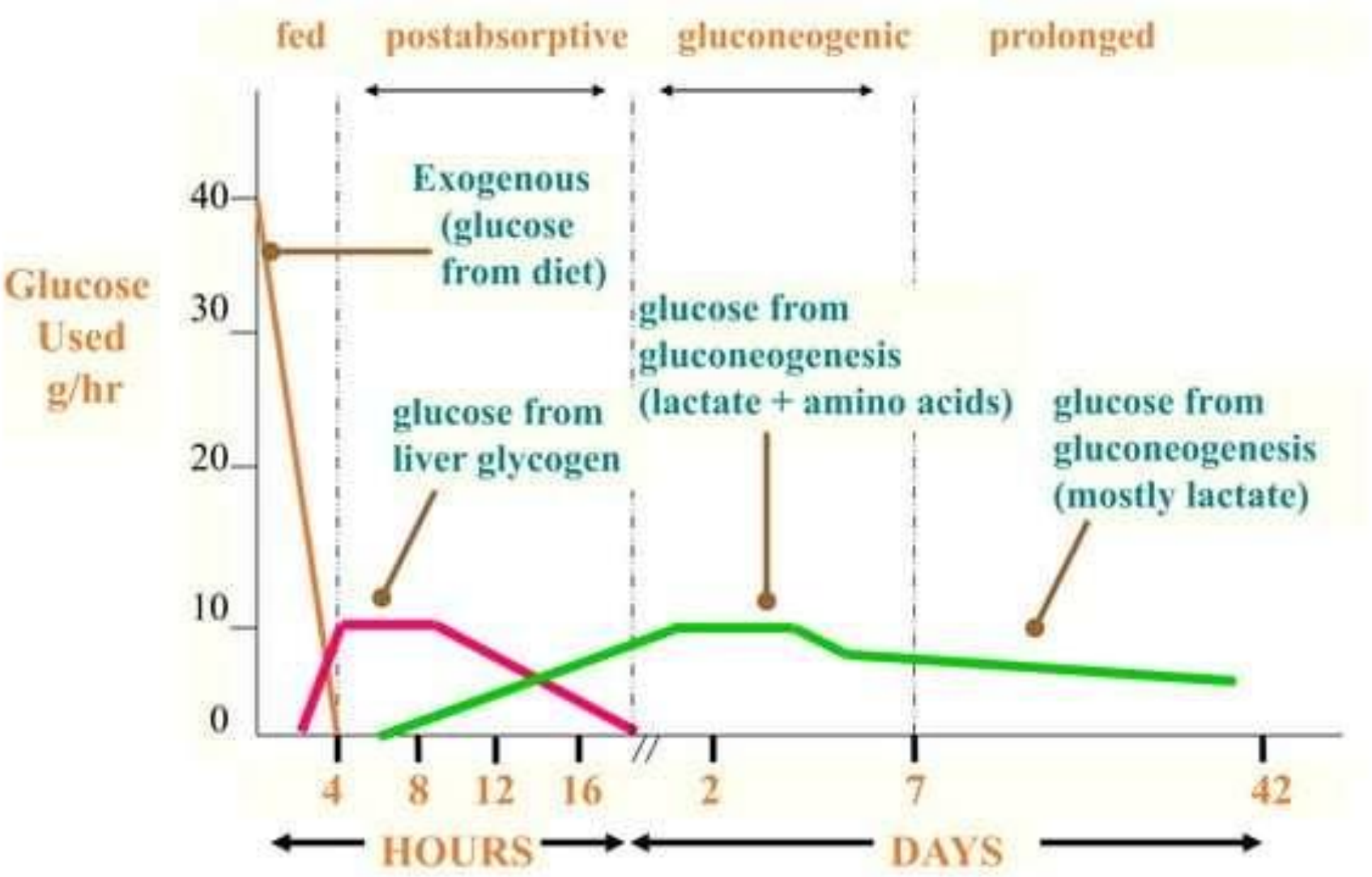

Figure 4. Sources of blood glucose in the various nutritional states

- In post absorptive period, liver derives its energy from oxidation of fatty acids released from adipose tissue.
- Liver synthesizes & releases ketone bodies.
- Ketone bodies used as energy source by extrahepatic tissues including brain.
- Although glucose is the main source of energy for brain, only 20% energy comes from ketone bodies.

Hormones

1. Insulin

- Produced by β cells of pancreas

- Major site of action:

- Liver
- Muscle
- Adipose tissue

- In liver, insulin decreases production of glucose by inhibiting
- Glycogenolysis
- Gluconeogenesis

- In muscle & liver, insulin increases
- Glycogen synthesis

- In muscle & adipose tissue, insulin
- ↑ glucose uptake

Glucagon

- Secreted by α cells of islets of pancreas
- Stimulus for secretion – hypoglycemia
- Along with epinephrine, cortisol & growth hormone oppose insulin action

2.GLUCAGON:

- promotes glycogen breakdown in liver
  - -inhibits glycogen synthesis.
  - -inhibits glycolysis.
  - -enhances gluconeogenesis.

3.EPINEPHRINE:

- promotes glycogenolysis in liver & muscle.
-decreases glycogenesis.
-increases gluconeogenesis.

4. CORTISOL.

- increases gluconeogenesis.

- **5.GROWTH HORMONE.**

- ↓ glucose uptake in muscle