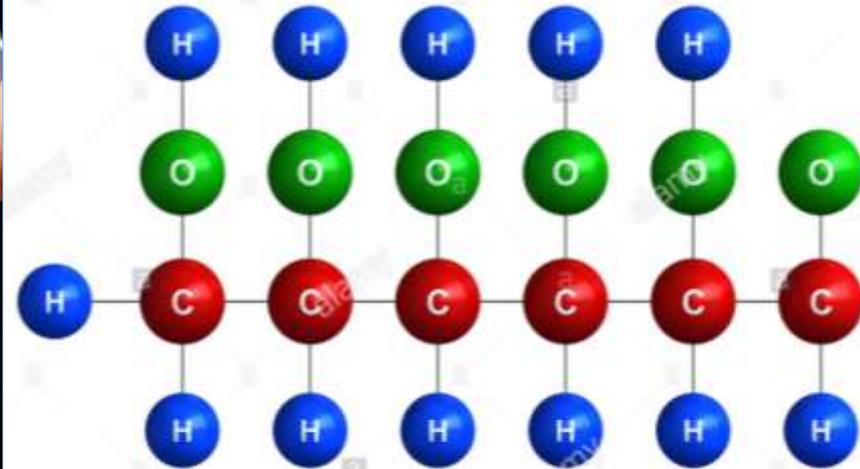
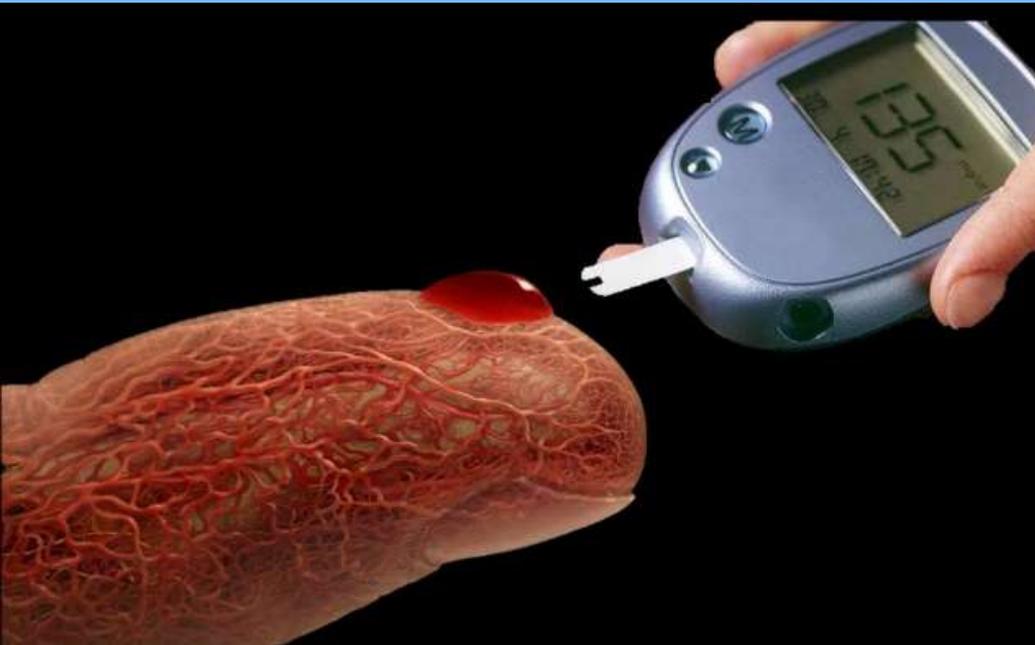


BLOOD GLUCOSE REGULATION



Glucose $C_6H_{12}O_6$

MOHAMMAD SHAHRUKH
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Blood Glucose Regulation

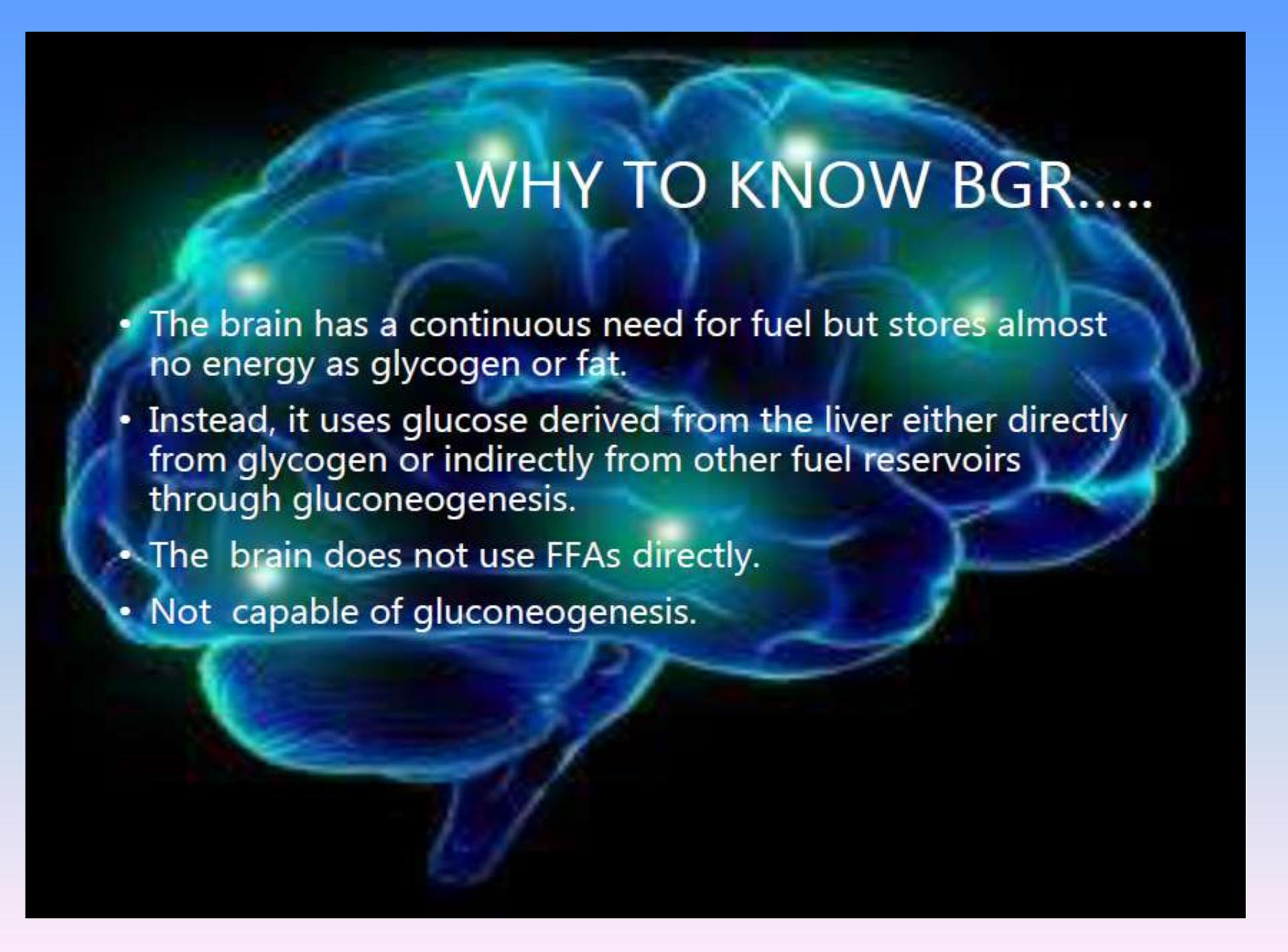
Normal plasma glucose

Factors maintaining blood glucose

Post-prandial regulation

Regulation during fasting

Clinical aspect



WHY TO KNOW BGR.....

- The brain has a continuous need for fuel but stores almost no energy as glycogen or fat.
- Instead, it uses glucose derived from the liver either directly from glycogen or indirectly from other fuel reservoirs through gluconeogenesis.
- The brain does not use FFAs directly.
- Not capable of gluconeogenesis.

Glucose Homeostasis ???

- It is the maintenance of blood glucose level within the normal range.
- The blood glucose level must be maintained within the narrow limits of 70-100 mg/dl.

FIVE PHASES OF GLUCOSE HOMEOSTASIS

- ❖ Well fed state (< 4 hrs)
- ❖ Hepatic glycogenolysis(16 hrs)
- ❖ Hepatic gluconeogenesis (<40 hrs)
- ❖ Gluconeogenesis & ketogenesis (24 days)
- ❖ Ketogenesis mainly (40 days)

NORMAL VALUES- common terms

FASTING PLASMA
GLUCOSE [FPG/FBS]

- A FBS is taken after at least eight hours of fasting

RANDOM PLASMA
GLUCOSE [RBS/RPG]

- Test done any time of day without regard to time since last meal.

POST-PRANDIAL
BLOOD GLUCOS [PPBS]

- The test done about 2 hr after a good meal

NORMAL VALUES

FASTING FBS

- 70-110mg/dL
- 4-6.1mmol/L

RANDOM RBS

- < 140 mg/dl
- <7.8 mmol/l

POST-PRANDIAL PPBS

- 140 mg/dL
- 7.8 mmol/L

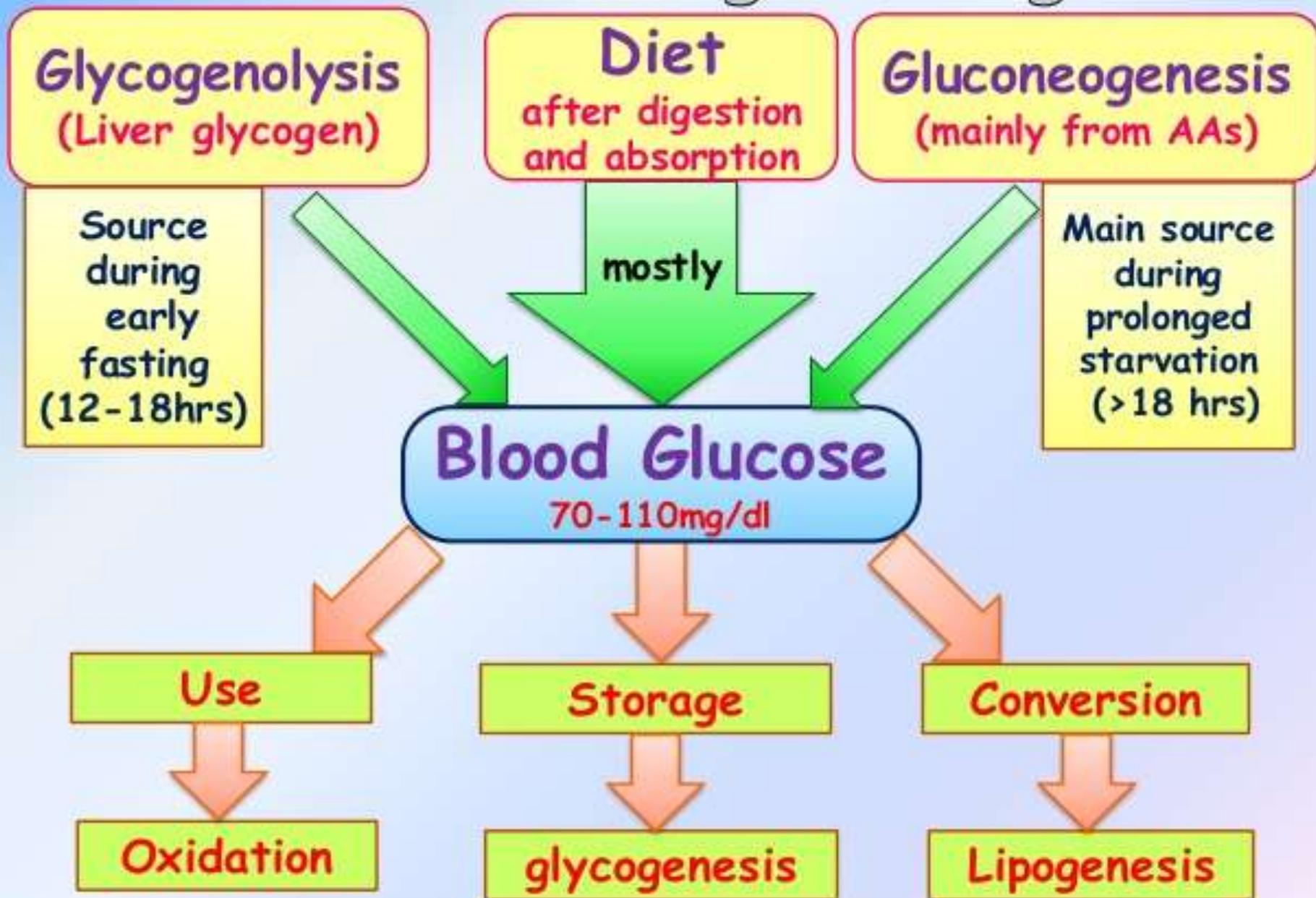
Hyperglycemia :

- Diabetes mellitus
- In hyperactivity of anterior pituitary & adrenal cortex
- In hyperthyroidism.
- pancreatitis

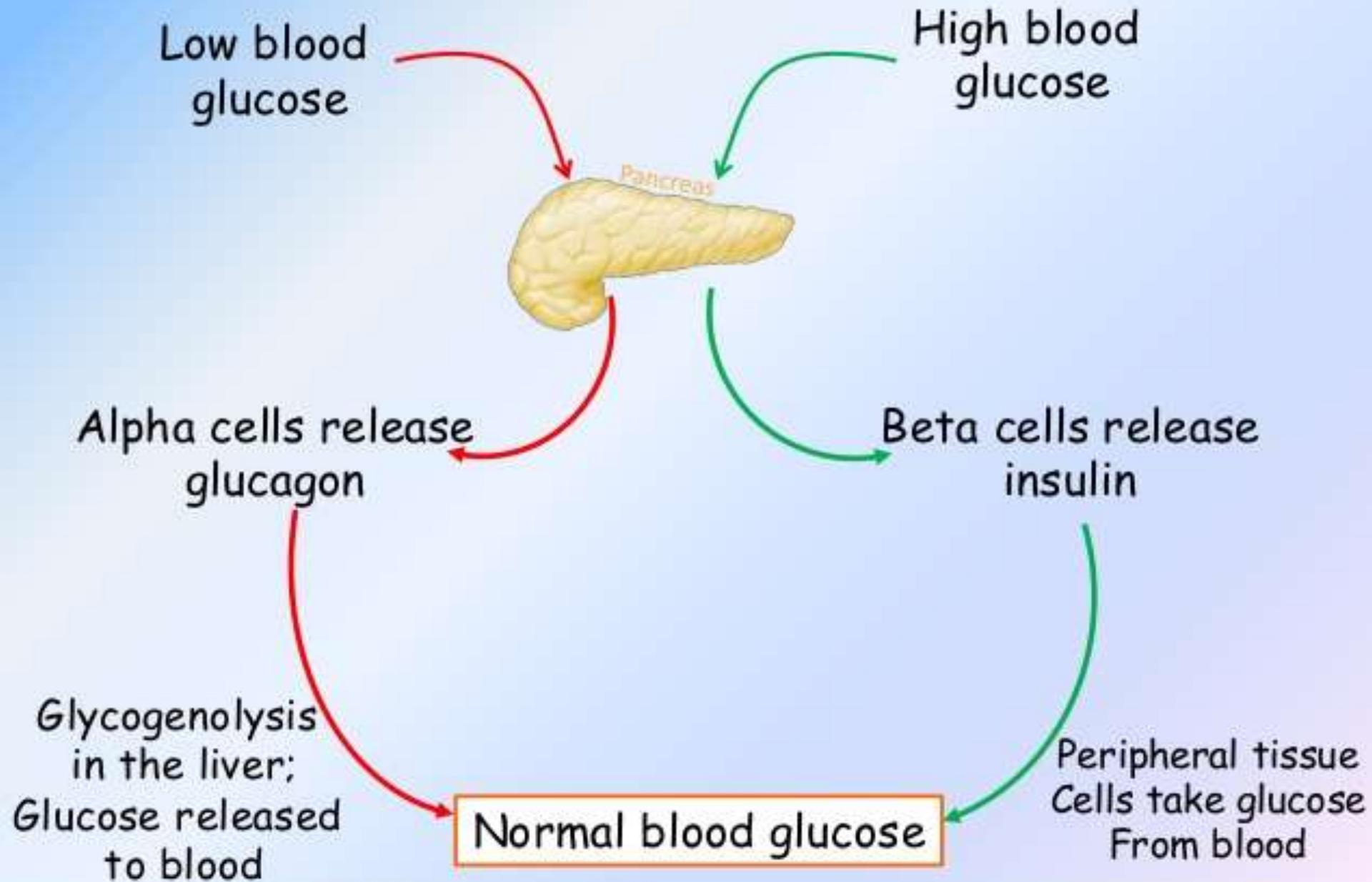
Hypoglycemia :

- overdosage of Insulin
- Hypopituitarism
- Hyperinsulinism
- Hypothyroidism
- Adrenal cortical hypofunction (such as Addison's disease)
- In decreased absorption, like sprue, coeliac disease.

Factors maintaining blood glucose



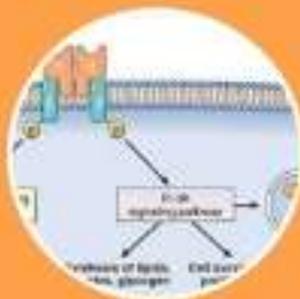
Homeostasis of blood glucose



Factors involving in the **homeostasis** of **blood glucose**



Metabolic
process



Hormones



Renal
mechanism



Fundamental Regulatory Mechanisms

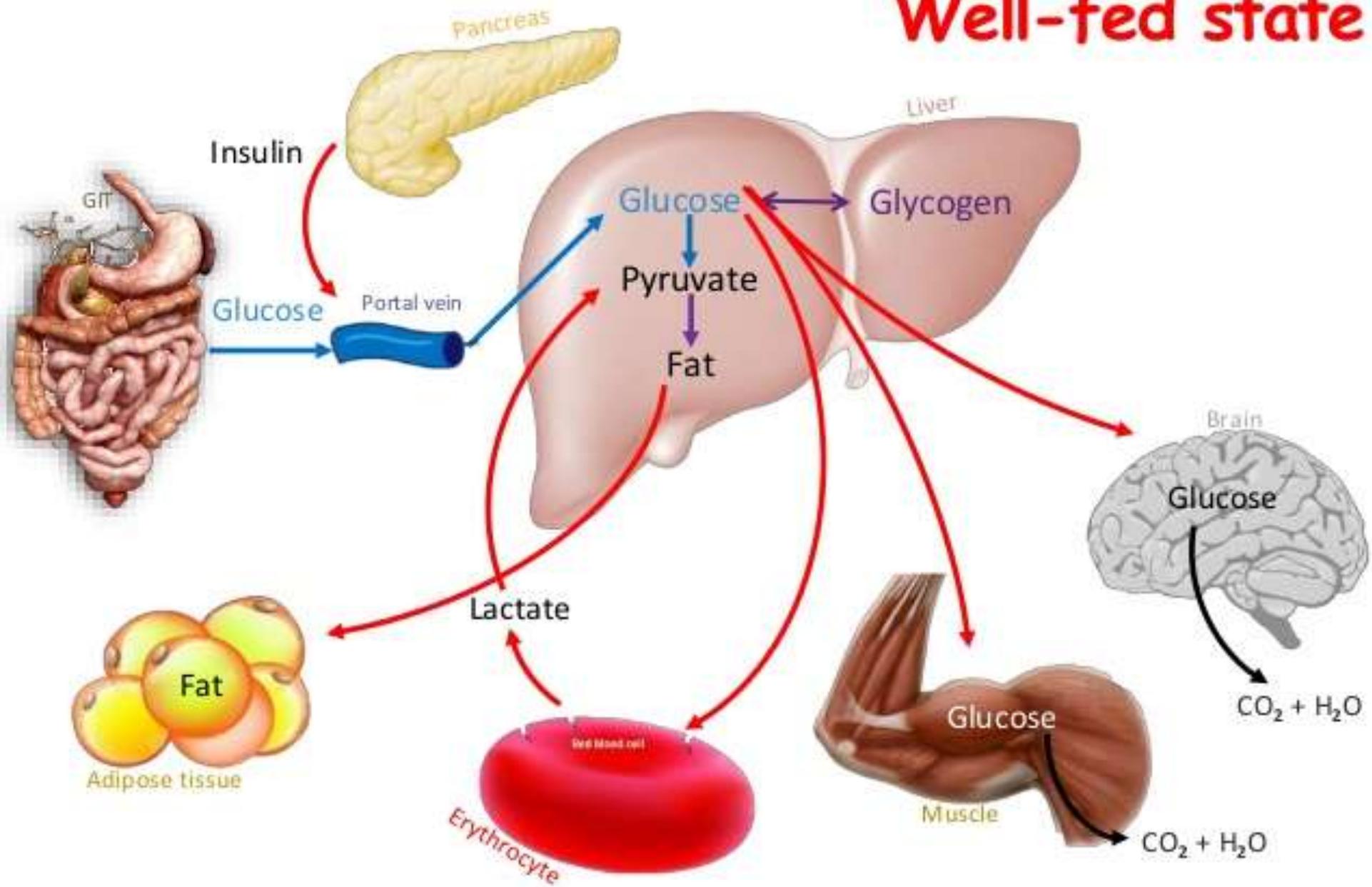
1. *As blood sugar tends to increase*

- ☒ ↑ Secretion of insulin,
- ☒ Glycogenesis is accelerated
- ☒ Utilisation of glucose by tissues is increased

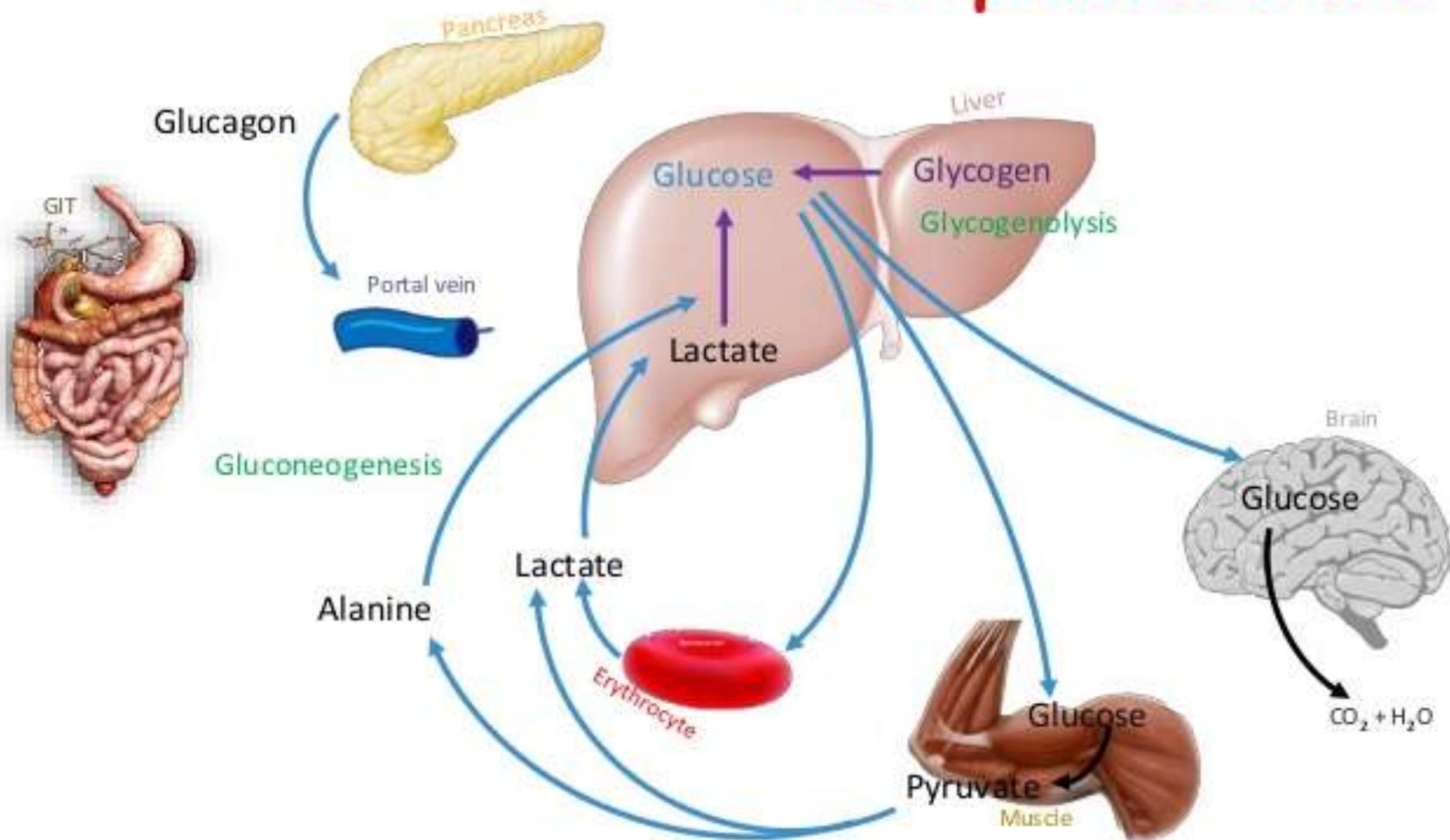
2. *As blood sugar tends to decrease*

- ☒ ↓ secretion of insulin,
- ☒ ↓ ratio of insulin/glucocorticoids and GH
- ☒ ↑ production of glucose mainly by gluconeogenesis & glycogenolysis
- ☒ ↓ Utilisation of glucose by tissues

Blood glucose regulation during Well-fed state



Blood glucose regulation during Post-prandial state



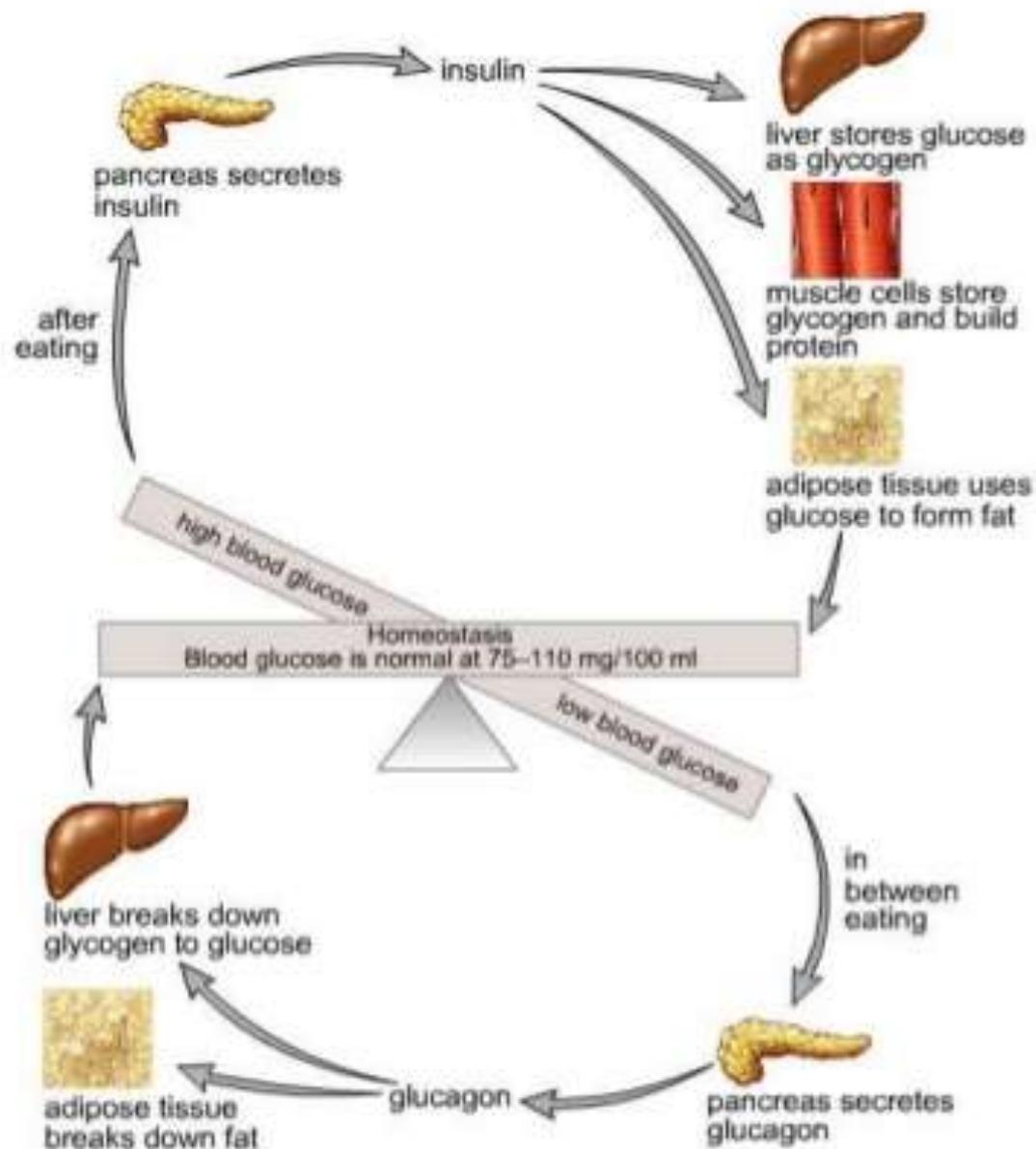
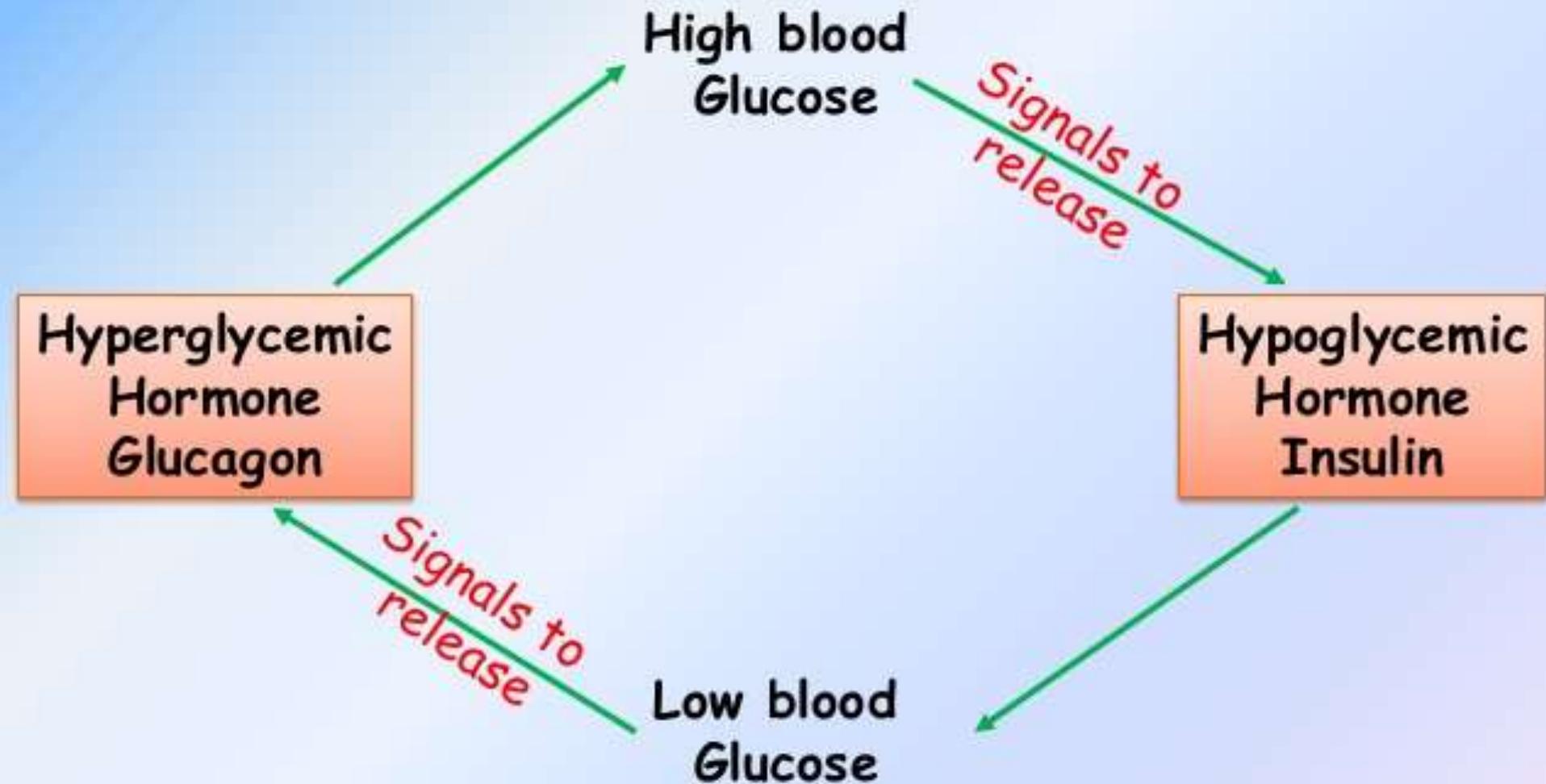


Figure 49.14
Regulation of blood glucose level.



Role of hormones

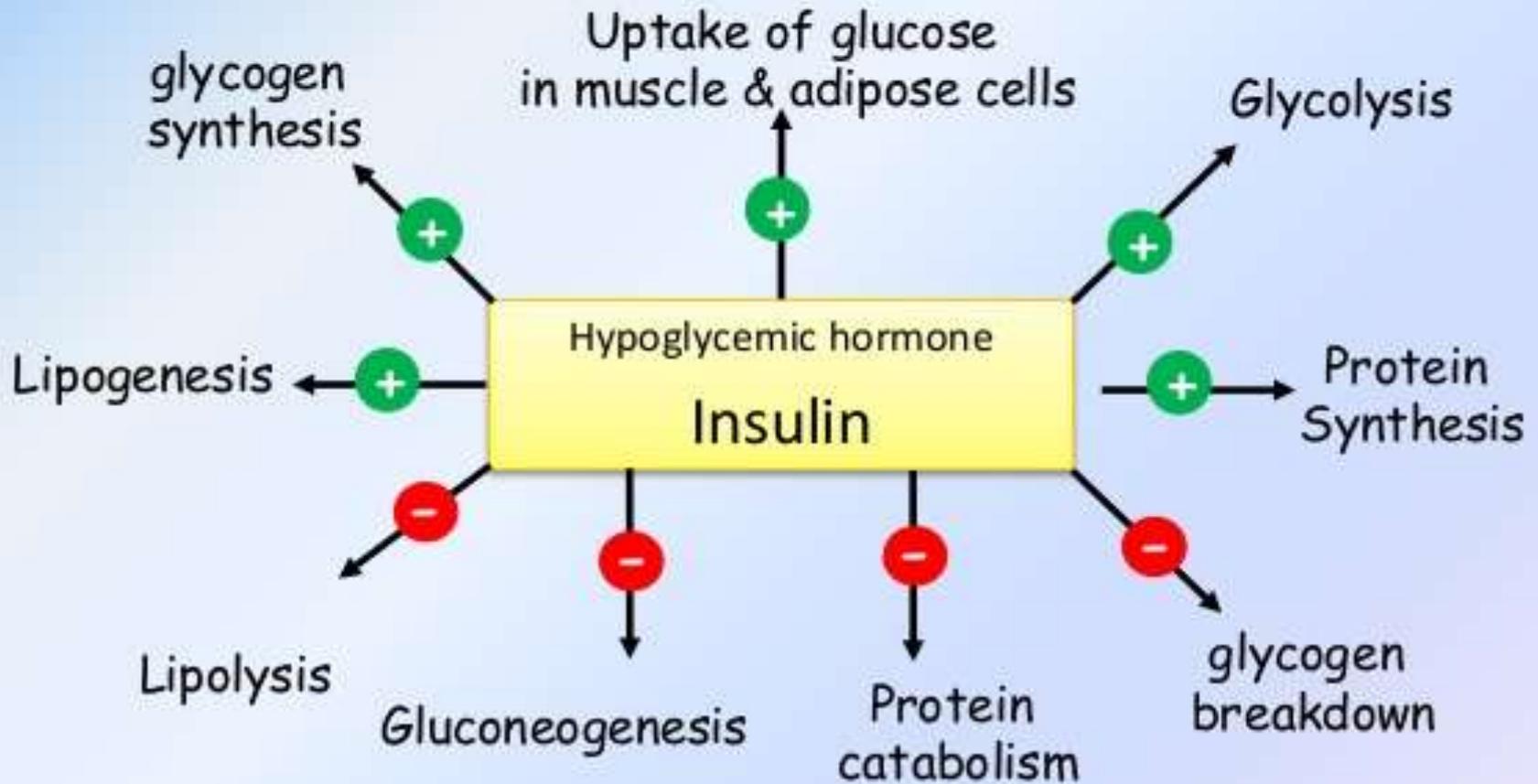


Insulin

- ⌘ Insulin is the first hormone to be **isolated, purified, crystallized & synthesized**.
- ⌘ Insulin secretion is associated with energy abundance.
- ⌘ Produced by beta cells of the pancreas
- ⌘ It is a small **protein** (with 51 AAs).
- ⌘ has a **molecular weight of 5808**.
- ⌘ It is composed of **two polypeptide chains** connected to each other by **disulfide linkages**

Role of insulin

Insulin acts at the transcriptional level to regulate synthesis of more than 100 proteins



ADIPOSE TISSUE

- Increased glucose entry
- Increased fatty acid synthesis
- Increased glycerol phosphate synthesis
- Increased triglyceride deposition
- Activation of lipoprotein lipase
- Inhibition of hormone sensitive lipase
- Increased K⁺ uptake

MUSCLE

- Increased glucose entry
- Increased glycogen synthesis
- Increased amino acid uptake
- Increased protein synthesis by ribosomes
- Decreased protein catabolism
- Decreased release of gluconeogenic amino acids
- Increased ketone uptake
- Increased K⁺ uptake

Liver

- Decreased ketogenesis
- Increased protein synthesis
- Increased lipid synthesis
- Decreased glucose output due to decreased gluconeogenesis,
- Increased glycogen synthesis, and
- Increased glycolysis

General

- Increased cell growth

Hyperglycemic Hormones

1. Glucagon
2. Epinephrine or Adrenaline
3. Glucocorticoids
4. ACTH
5. Growth hormone
6. Thyroxine

All these are anti-insulin hormones.

Glucagon

- ⊞ produced by the **α -cells** of the islets of Langerhans of the pancreas.
- ⊞ Glucagon opposes the actions of insulin.
 - ⊞ Increases Blood Glucose
 - ⊞ Promotes Glycogenolysis
 - ⊞ Depresses Glycogen Synthesis
 - ⊞ Inhibits Glycolysis
 - ⊞ Enhance Gluconeogenesis

Epinephrine or Adrenaline

✂ It is secreted by adrenal medulla.

☑ Increases blood glucose

☑ Promotes glycogenolysis

☑ Enhance gluconeogenesis

☑ Favors uptake of AAs.

Glucocorticoids

- ✂ It is secreted by adrenal cortex,
 - ☑ increases blood glucose
 - ☑ Enhance gluconeogenesis
 - ☑ Releases AAs from muscle

CORTISOL EFFECTS

- Metabolic PPAR- γ
- Tryptophan hydroxylase
- Tyrosine aminotransferase
- Metalloprotease
- Glutamine synthase
- Glycogen synthase
- Glucose-6-phosphatase
- PEPCK
- γ -Fibrinogen
- Cholesterol 7 α -hydroxylase

THYROID HORMONES

- Thyroid hormones make experimental diabetes worse.
- The principal diabetogenic effect of thyroid hormones is to increase absorption of glucose from the intestine,
- But the hormones also cause (probably by potentiating the effects of catecholamines) some degree of hepatic glycogen depletion.

Renal mechanism

- ✘ When blood glucose rises to relatively high levels, kidney also exerts a regulatory effect.
- ✘ Glucose is continuously filtered by the glomeruli but is normally reabsorbed completely in renal tubules.
- ✘ If the bl glucose level is raised above **180mg/dl**, complete tubular reabsorption does not occur.
- ✘ The extra amount appears in the urine causing glycosuria
- ✘ And it is called renal threshold value for glucose.

RENAL REGULATION

Glucosuria Occurs When the Renal Threshold for Glucose Is Exceeded

Tubular maximum

350mg/min

Renal threshold

180mg/ml

Glycosuria

Glycosuria

- ✘ Normally the urine contains about 0.05gm/dl of sugar.
- ✘ Which cannot be detected by Benedict's test.
- ✘ But under certain circumstance considerable amount of glucose or other sugar may be excreted in the urine.
- ✘ Excretion of detectable amount of sugar in the urine is known as **glycosuria**.
- ✘ Generally is called as "sugar in the urine".
- ✘ Glucosuria may different type....
 - ☒ Alimentary (lag storage) glucosuria
 - ☒ Renal glucosuria
 - ☒ Diabetic glucosuria.



thank you!