Let's Excel Together

CANADIAN ACADEMY OF SPORTS NUTRITION

Lecture 86:

Endocrine System and Exercise

Hormonal Changes During Exercise and Playing Sports

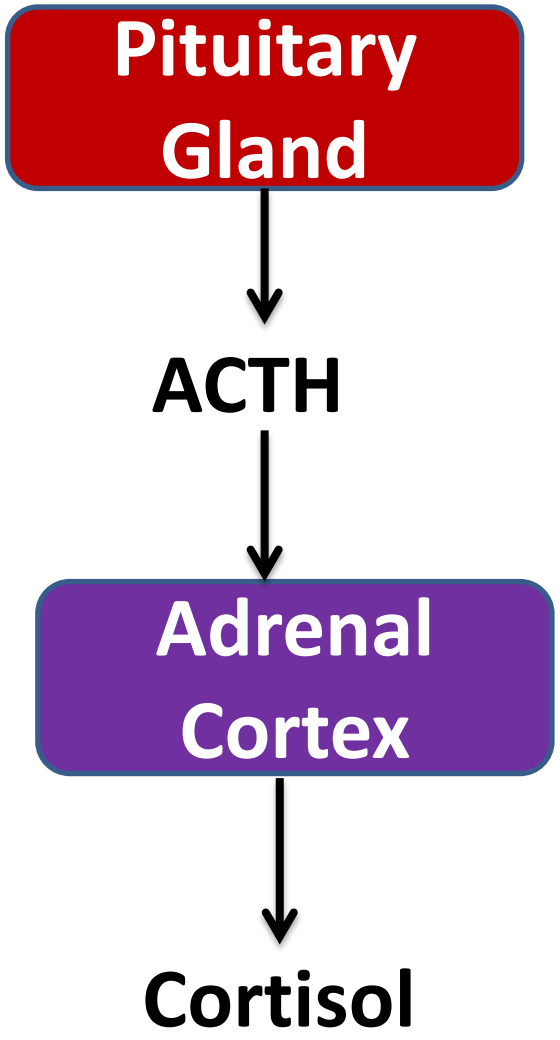
Part 2

Copyright Protection:

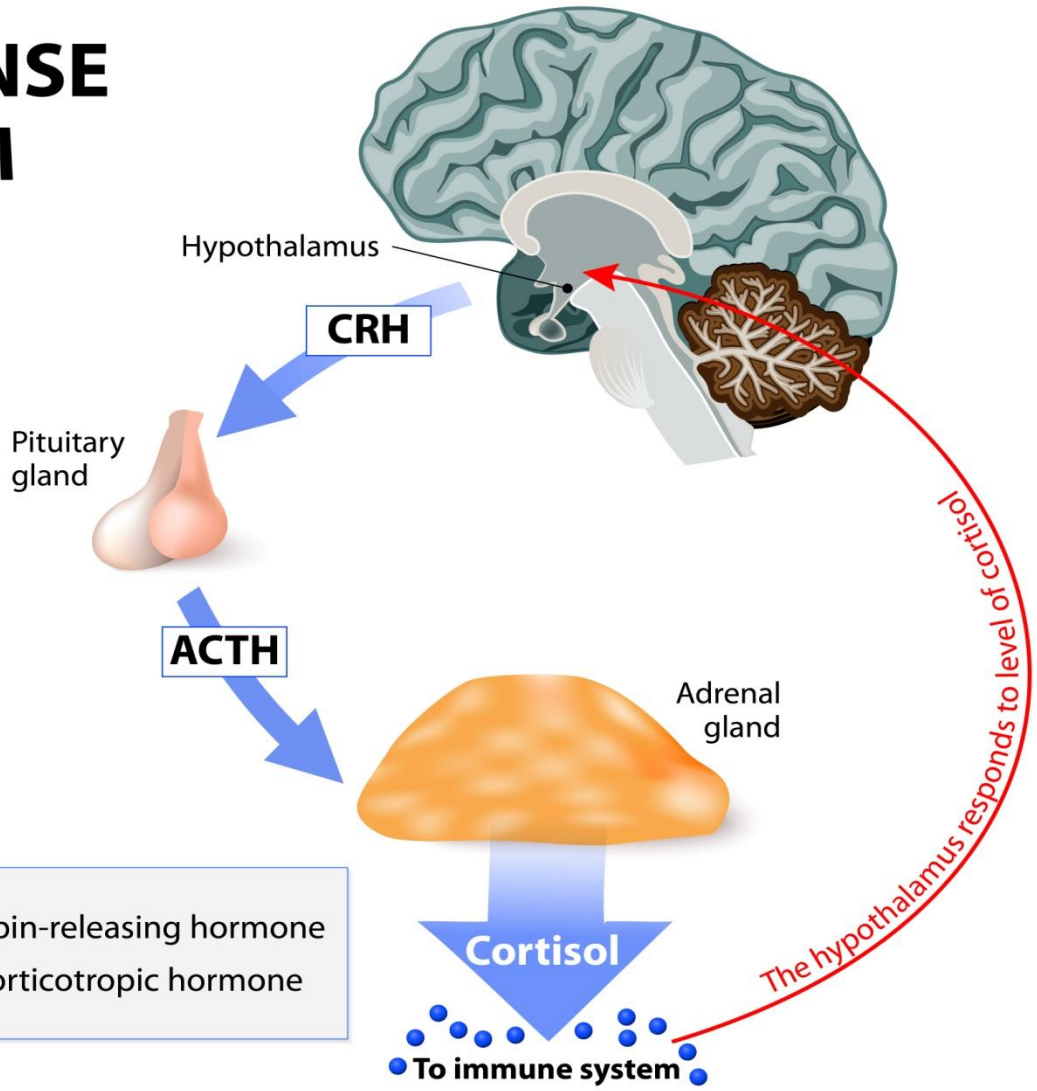
The following hormones will be discussed during this lecture:

- **ACTH.**
- **Prolactin.**
- **Insulin.**
- **Glucagon.**
- **ADH.**
- **Oxytocin.**
- **Catecholamines.**
- **β- Endorphins**

ACTH (Adrenocorticotropic Hormone):



STRESS RESPONSE SYSTEM

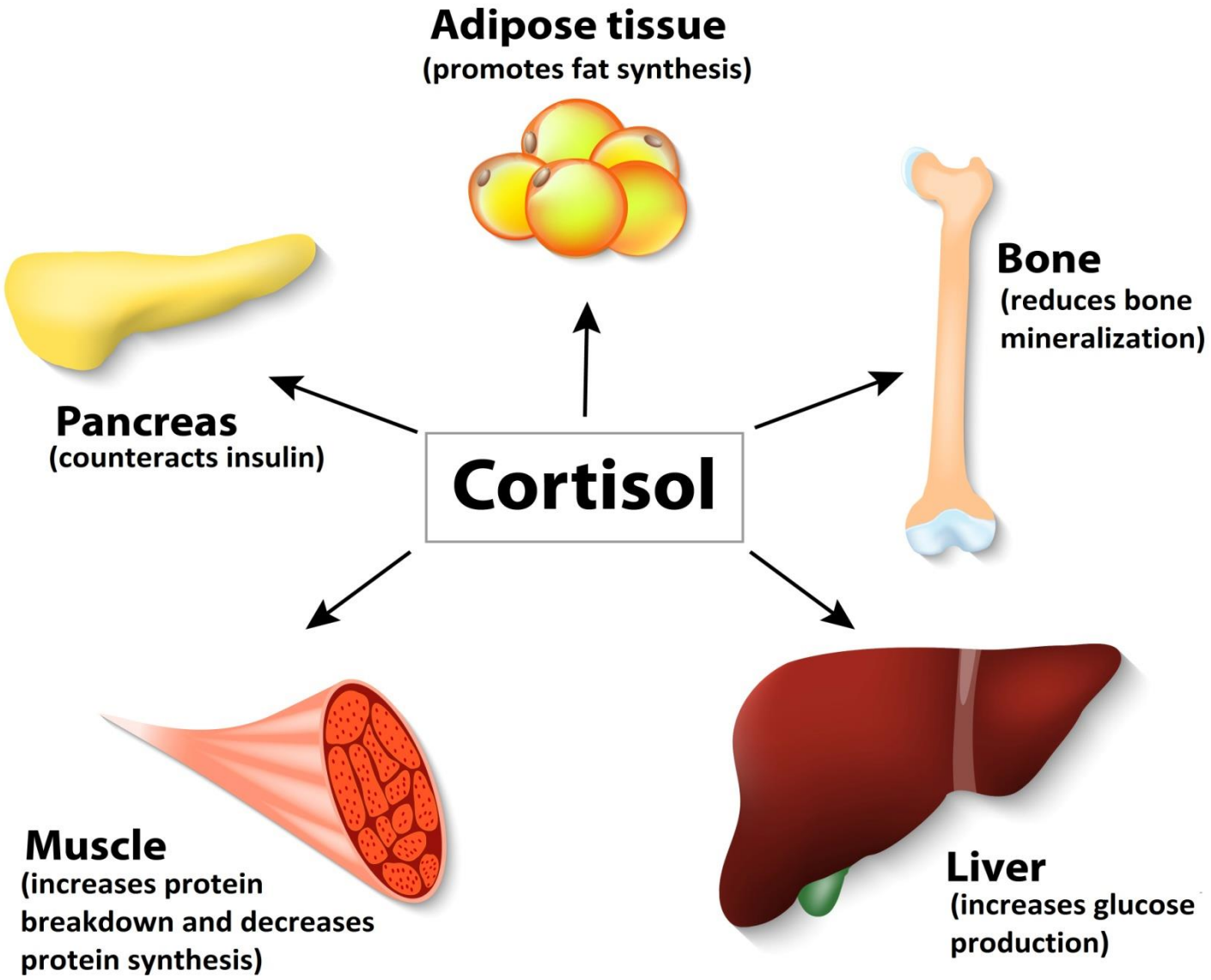


CRH - Corticotropin-releasing hormone

ACTH - Adrenocorticotropic hormone

Effects of Cortisol:

- **Liver:** ↑ glucose production.
- **Muscle:** ↑ protein breakdown, ↓ protein synthesis
- **Adipose tissue:** ↑ fat synthesis
- **Bones:** ↑ demineralization
- **Other tissues:** ↓ glucose and amino acid uptake


Adipose tissue
(promotes fat synthesis)
Bone
(reduces bone mineralization)
Pancreas
(counteracts insulin)
Cortisol
Muscle
(increases protein breakdown and decreases protein synthesis)
Liver
(increases glucose production)

ACTH, Cortisol and Exercise:

- **ACTH is controlled by CRH released from the hypothalamus.**

- **ACTH release exhibits a diurnal pattern, with the highest levels in early morning just after waking up.**

- **ACTH level may increase proportionately with exercise intensity and duration if intensity exceeds 25% of aerobic capacity.**

- **Along with ACTH, cortisol level elevates with exercise both in endurance and strength athletes.**

- **Compared to strength athletes, cortisol raise is smaller in endurance athletes.**

- **It seems that there is a positive correlation between cortisol level and blood lactate and serum creatine kinase levels.**

Few studies indicate that variations in cortisol levels during resistance training may be affected by :

- **Total training volume.**
- **Number of sets per training.**
- **Rest between sets.**

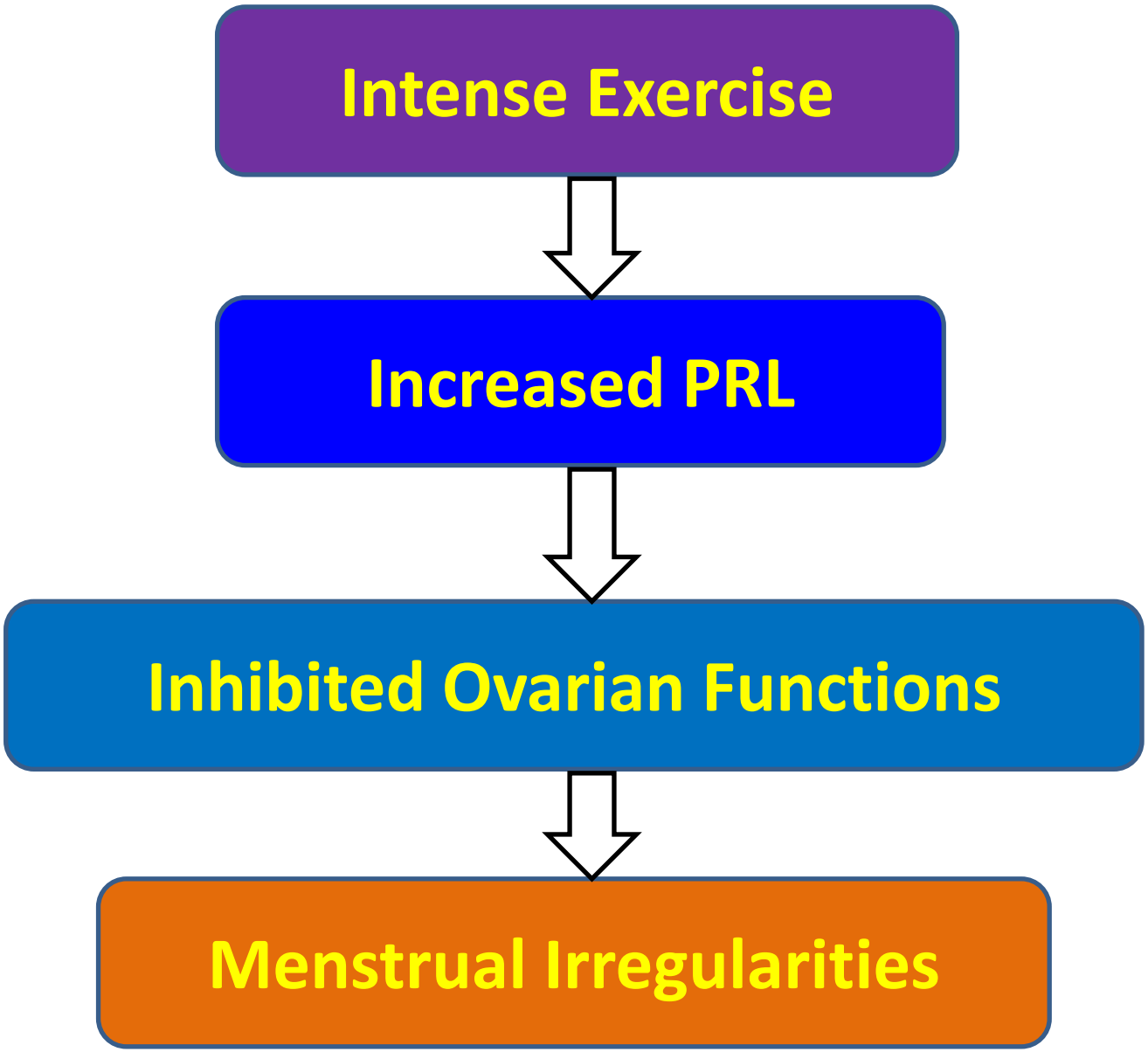
- **Even though high levels of cortisol for long term have adverse effects, acute raise in cortisol level may have the following benefits:**

- **1) assists in the muscle tissue remodeling process.**

- **2) spares glycogen stores which is limited in the body. This is why consuming carbohydrates during exercise limits the raise in cortisol level.**

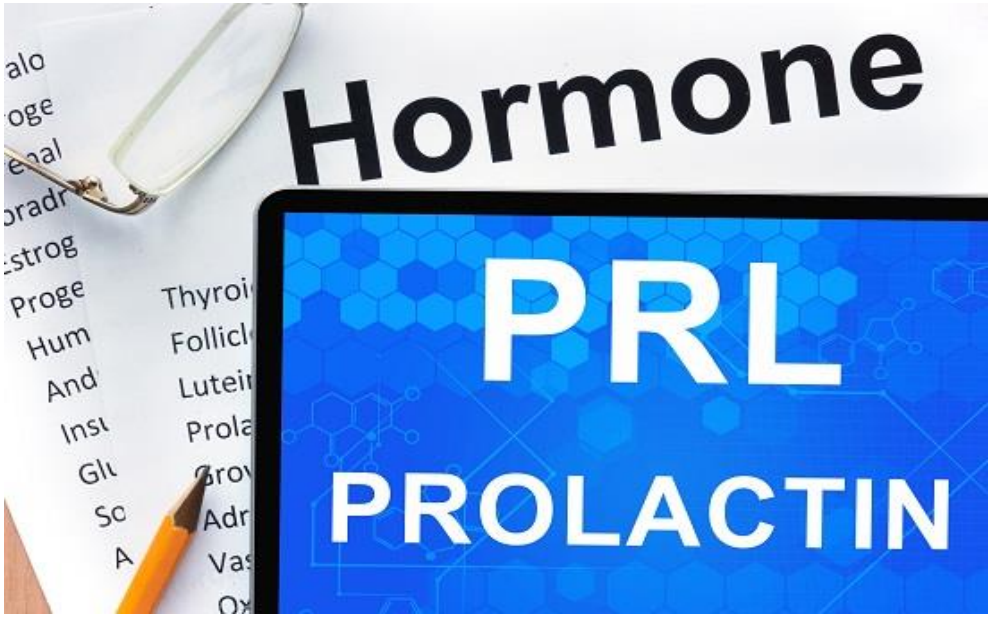
Prolactin (PRL):

- Is released from anterior pituitary.
- Initiates and supports milk production from mammary glands.
- PRL increases with high intensity exercises and returns back to normal within 45 minutes during recovery.


Intense Exercise
Increased PRL
Inhibited Ovarian Functions
Menstrual Irregularities

- **This hormone also increases in men in exercises with maximal intensity.**

- **Some evidences indicate that training lowers resting values in endurance athletes.**



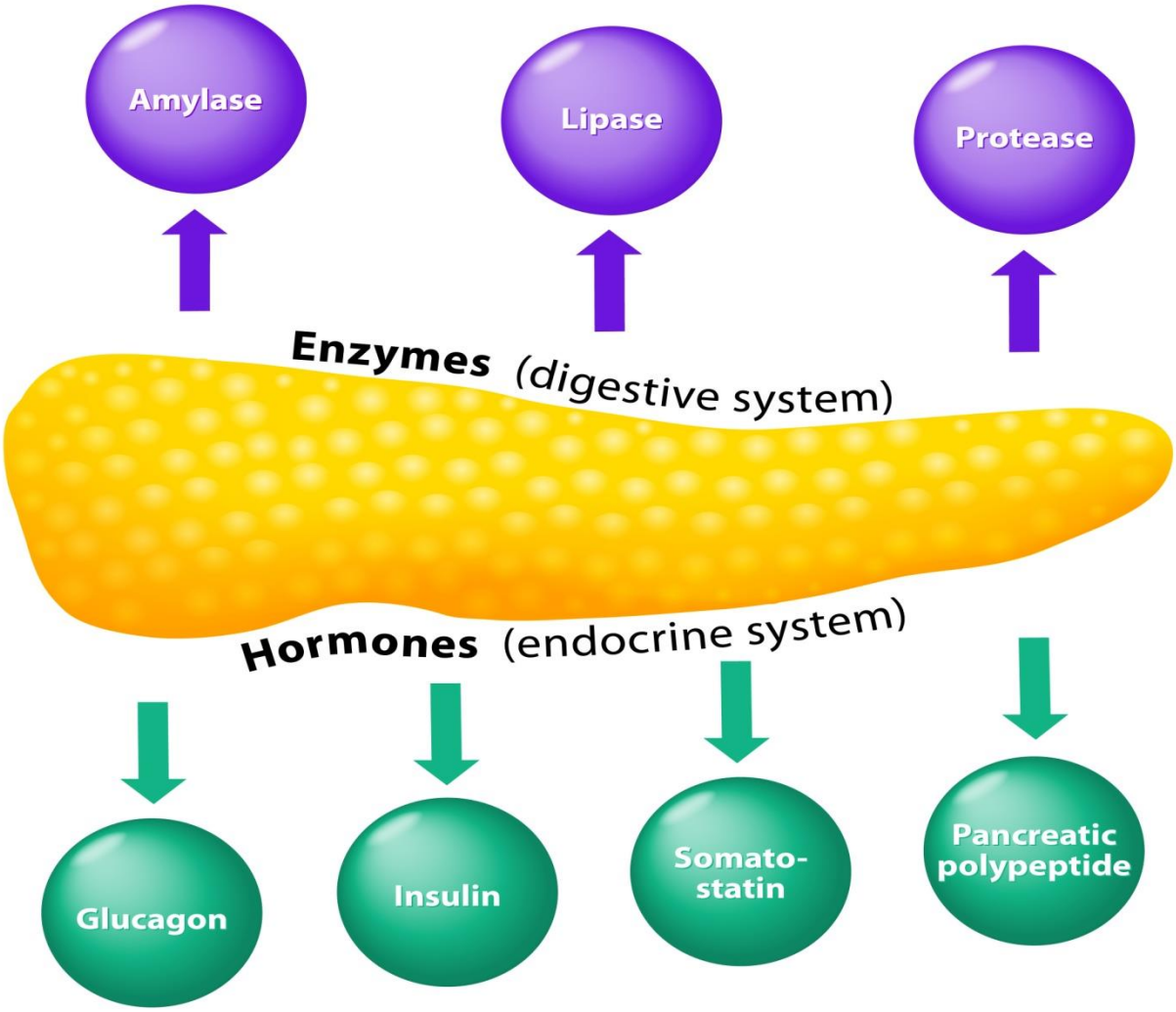
Insulin:

- **Insulin is released from β – cells of the pancreas.**

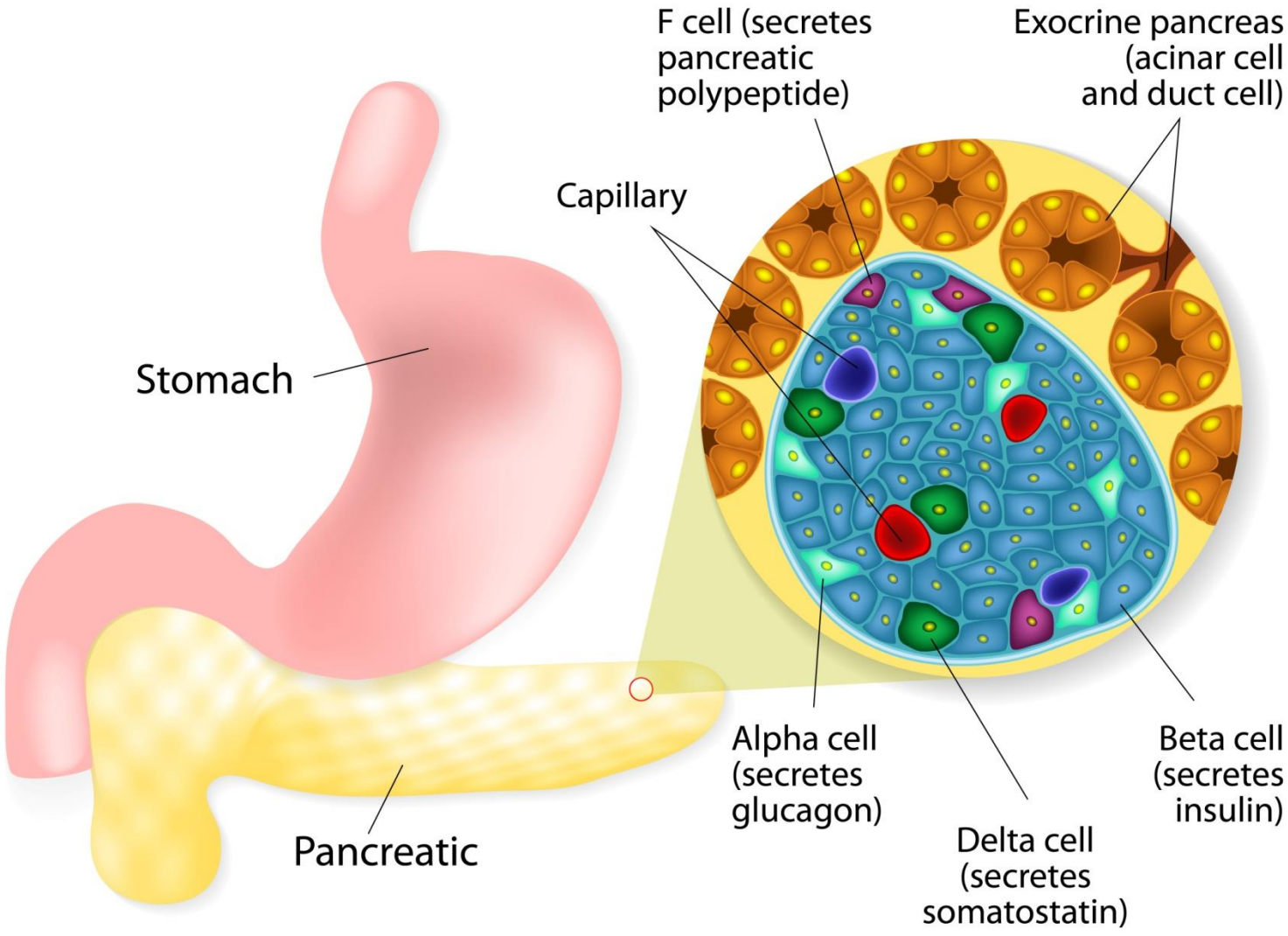
Insulin regulates glucose uptake by all tissues especially muscle and adipose tissues, except:

- ***Nervous system.***
- ***Kidney tubules.***
- ***Red blood cells.***
- ***Beta-cells of pancreas.***

PANCREAS


Amylase
Lipase
Protease
Enzymes (digestive system)
Hormones (endocrine system)
Glucagon
Insulin
Somato-
statin
Pancreatic
polypeptide

ISLETS OF LANGERHANS



Insulin and Exercise:

- **Increased sensitivity to insulin especially within 30 minutes after exercise.**

- **Normal decrease in insulin during exercise .**

Glucagon:

- Glucagon is released from α– cells of the pancreas.
- It is the "insulin antagonist" hormone and increases blood glucose level by affecting :
- Adipose tissue: ↑lypolysis
- Liver: ↑gylcogenolysis, ↑gluconeogenesis, ↑protein breakdown, ↓ketone synthesis

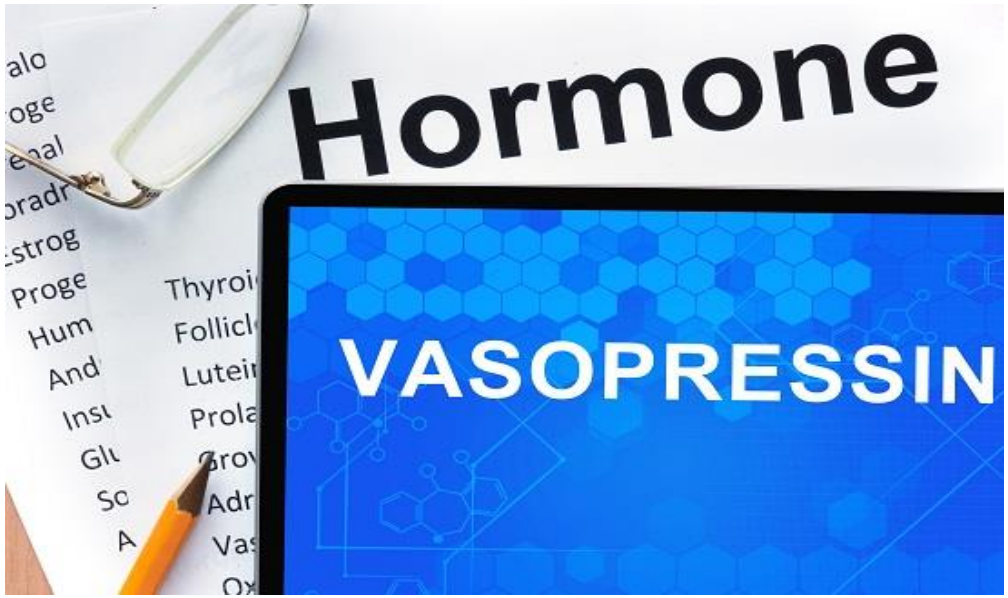
Glucagon and Exercise:

- **Small increase at the start of exercise.**

- **Greater increase later during exercise as glycogen reserve depletes and blood glucose drops.**

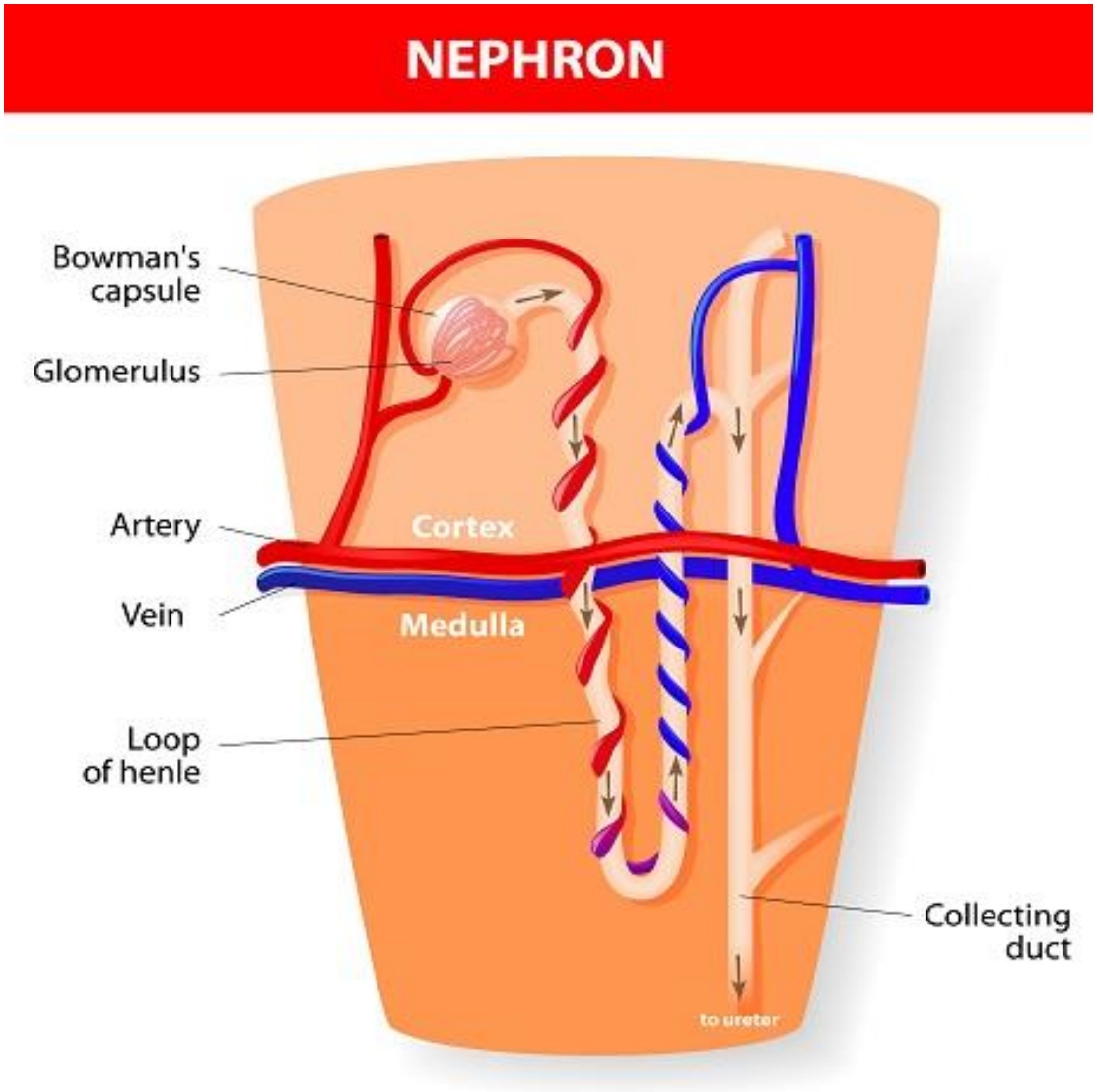
ADH (Antidiuretic Hormone):

- **ADH is synthesized by the hypothalamus and then transferred to be stored in the posterior pituitary gland.**
- **Its other name is AVP (arginine vasopressin).**



- **It increases water reabsorption by the kidneys.**

- **Deficiency of ADH causes *diabetes insipidus*.**



ADH and Exercise:

- **Changes in ADH levels depend on intensity and duration of exercise and hydration status of athlete.**

- **Minimal or no changes in mild exercise of short duration.**

- **Increased concentration in an intense exercise and in moderate exercise of long duration.**

Oxytocin:

- **Like ADH, it is synthesized by the hypothalamus and then transferred to be stored in the posterior pituitary gland.**

- **It plays a key role in intimacy and sexual arousal. This is why it is famous as "*Love Hormone*".**

- **It is a neuropeptide that has been linked to positive emotions and cognition including partner preferences, parental behavior, sexual behavior, social memory, and pair bonding.**

Oxytocin and Exercise:

- **Oxytocin has been linked to key processes relevant to team sport, such as empathy, trust, generosity, altruism, cohesion, cooperation, and motivation.**

- **It provides an important biopsychological basis for athletic performance in team sports.**

- **Few studies indicate that oxytocin increases with exercise.**
- **It may have a role in "*Athletic Discrepancy Syndrome*".**

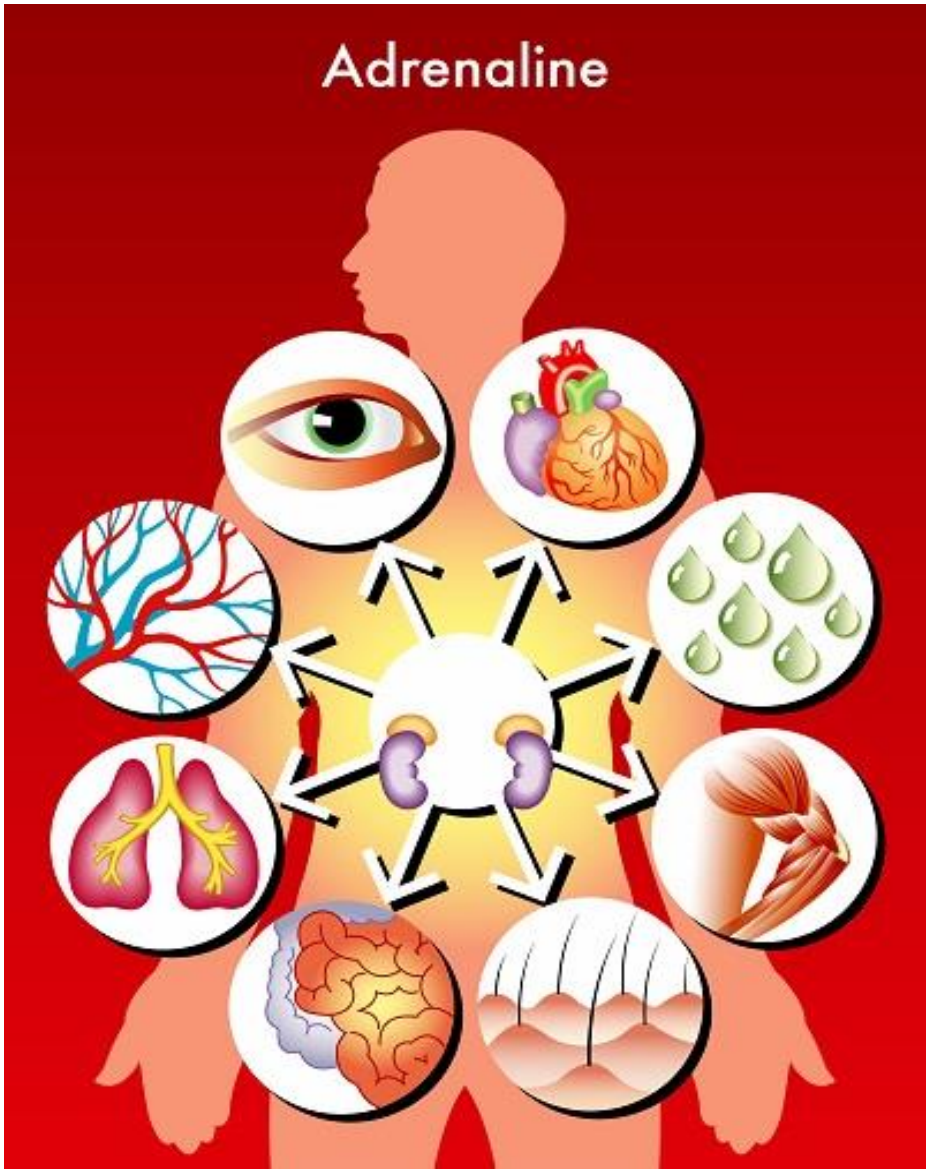
Catecholamines:

- They are hormones made from the amino acid tyrosine.

Catecholamines are:

- Epinephrine (adrenaline)....from adrenal medulla
- Norepinephrine (noradrenaline) ....from adrenal medulla
- Dopamine.....from brain.

- **Epinephrine and norepinephrine from the adrenal glands are a part of the fight-or-flight response .**

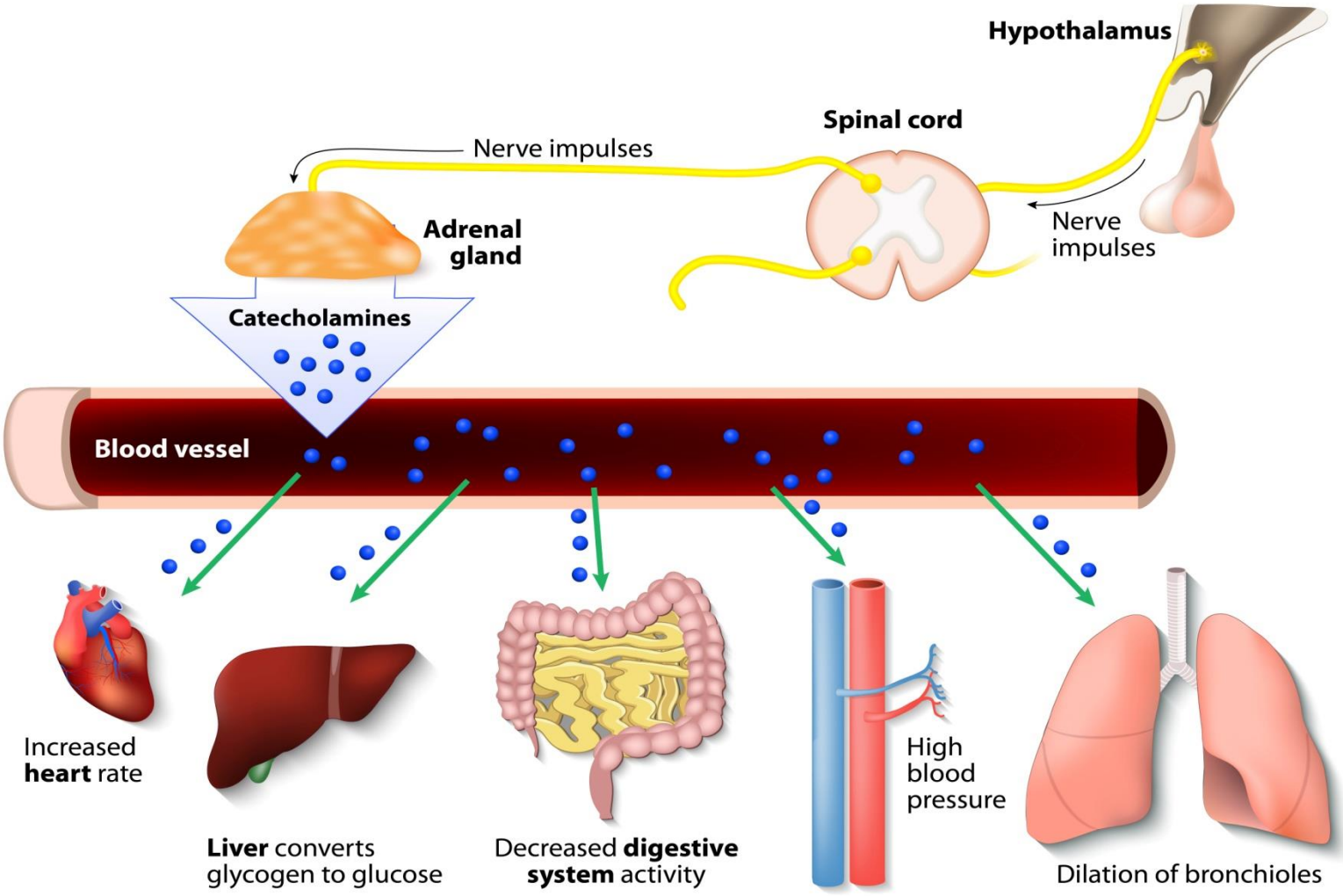


Catecholamines and Exercise:

- **Increased levels by an acute bout of resistance training.**

- **Decreased levels at rest.**

The activation of the stress system



β- Endorphins:

- **They are opioid neuropeptides found in the nervous system.**

- **They have been linked to "*Exercise High or Runner`s High*", a state described as euphoria and exhilaration as the duration of moderate-to-intense aerobic exercise increases.**

What is “Exercise High or Runner`s High”?

- When you are doing a moderate-to-intense aerobic exercise such as running, as the duration of exercise increases, you experience a state of euphoria and exhilaration.

- This is famous as "Exercise High" or "Runner's High".

- **It is a particular exhilarating feeling of satisfaction and jubilation that especially occurs following long duration aerobic activities.**

- **Once you experience exercise high, you want to experience it more!**

- **This psychosomatic state could be experienced in any long-duration, rhythmic-type exercise.**

- **The culprit of "*exercise high*" is the release of β-endorphins from the brain, which have morphine-like effects on the body.**

Other functions of β- Endorphins:

- They may increase pain tolerance.
- Improve appetite control.
- Reduce anxiety, tension, anger and confusion.
- Also regulate other hormones such as catecholamines and ACTH.

β- Endorphins and Exercise:

- **Exercise increases β-endorphins levels both in men and women, though this is a bit controversial.**

- **The response varies among individuals and varies inversely with exercise intensity.**

Homework:

- **1) Describe how stressors could affect the body.**

- **2) Describe “exercise high or Runner`s high”.**