Homeostasis

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PROGRAMME OUTCOMES

- PO1- Demonstrate comprehensive knowledge and application of the Trisutra concept to explore root causes, identify clinical manifestations of disease to treat ailments and maintain healthy status.
- PO2- Demonstrate knowledge and skills in Ayurveda, acquired through integration of multidisciplinary perspectives and keen observation of clinical and practical experiences.

COURSE OUTCOMES

- CO1- Explain all basic principles & concepts of Kriya Sharir along with essentials of contemporary human physiology and biochemistry related to all organ systems.

- **Teaching learning methods-** lecture with power point presentation
  Domain- Cognitive/comprehension
  Must to know / desirable to know / Nice to know- Must to know
  Millers pyramid- Knows how(applied knowledge)

- ‘Homeostasis’ refers to the maintenance of constant internal environment of the body (homeo = same; stasis = standing).
- In the nineteenth century, Claude Bemard (a French Physiologist) was first to recognize the importance of maintaining a stable intemal environment.
- He enlightened the fact that the cells, tissues, organs and organ systems of the body are interconnected and live together in a shared (internal) environment called ‘milieu interieur’.
- Blood forms internal environment of the cell in terms of volume, (water) composition, ion concentrations, pH and temperature. This is regulated to normal (narrow) physiological limits with respect to minor changes in the body.
- A variety of physiological mechanisms which act to stabilize the internal environment, are called Homeostasis Mechanisms (A term coined by an American physiologist W. B. Cannon in the twentieth century). The adjustments in physiological systems that are responsible for the preservation of homeostasis are referred to as Homeostatic Regulation.

- **ROLE OF VARIOUS SYSTEMS OF THE BODY IN HOMEOSTASIS**

One or more systems are involved in homeostatic mechanism of each function. Some of the functions in which the homeostatic mechanism is well established are given below:

1. The pH of the ECF has to be maintained at the critical value of 7.4. The tissues cannot survive if it is altered. The respiratory system, blood and kidney help in the regulation of pH.
2. Body temperature must be maintained at 37.5°C. Increase or decrease in temperature alters the metabolic activities of the cells. The skin, respiratory system, digestive system, excretory system, skeletal muscles and nervous system are involved in maintaining the temperature within normal limits.
3. Nutrients are essential for various activities of the cell and growth of the tissues. Nutrients must be digested, absorbed into the blood and supplied to the cells. Digestive system and circulatory system play major roles in the supply of nutrients.
4. Respiratory system is concerned with the supply of oxygen and removal of carbon dioxide. Kidneys and other excretory organs are involved in the excretion of waste products.

5. Hormones are to be synthesized and released from the endocrine glands in appropriate quantities and these hormones must act on the body cells appropriately. Otherwise, it leads to abnormal signs and symptoms.

6. Water and electrolyte balance should be maintained optimally. Otherwise it leads to dehydration or water toxicity and alteration in the osmolality of the body fluids. Kidneys, skin, salivary glands and gastrointestinal tract take care of this.

7. Skeletal muscles are also involved in homeostasis. This system helps the organism to move around in search of food. It also helps to protect the organism from adverse surroundings, thus preventing damage or destruction.

8. Central nervous system, which includes brain and spinal cord also, plays an important role in homeostasis. Sensory system detects the state of the body or surroundings. Brain integrates and interprets the pros and cons of these information and commands the body to act accordingly through motor system so that, the body can avoid the damage.

9. Autonomic nervous system regulates all the vegetative functions of the body essential for homeostasis.

- **COMPONENTS OF HOMEOSTATIC SYSTEM**

Homeostatic system in the body acts through self regulating devices, which operate in a cyclic manner. This cycle includes four components:

1. Sensors or detectors, which recognize the deviation
2. Transmission of this message to a control center
3. Transmission of information from the control center to the effectors for correcting the deviation. Transmission of the message or information may be an electrical process in the form of impulses through nerves or a chemical process mainly in the form of hormones through blood and body fluids
4. Effectors, which correct the deviation.

- **MECHANISM OF ACTION OF HOMEOSTATIC SYSTEM**
- Homeostatic mechanism in the body is responsible for maintaining the normalcy of various body systems. Whenever there is any change in behavioral pattern of any system, the effectors bring back the normalcy either by inhibiting and reversing the change or by supporting and accelerating the change depending upon requirement of the situation. This is achieved by means of feedback signals.
- Whenever any change occurs, system receives and reacts to two types of feedback:

1. Negative feedback
2. Positive feedback.

- **NEGATIVE FEEDBACK MECHANISMS**
- Most homeostatic mechanisms involve Negative feedback i.e. a corrective mechanism involving an action that directly opposes a variation from normal limits. Therefore, an increase or decrease in the variable being regulated brings about :responses that tend to push the variable in the direction opposite (negative) the direction of the original change.
- After receiving a message, effectors send negative feedback signals back to the system. Now, the system stabilizes its own function and makes an attempt to maintain homeostasis.

- For example, thyroid-stimulating hormone (TSH) released from pituitary gland stimulates thyroid gland to secrete thyroxine. When thyroxine level increases in blood, it inhibits the secretion of TSH from pituitary so that, the secretion of thyroxin from thyroid gland decreases. On the other hand, if thyroxine secretion is less, its low blood level induces pituitary gland to release TSH. Now, TSH stimulates thyroid gland to secrete thyroxine
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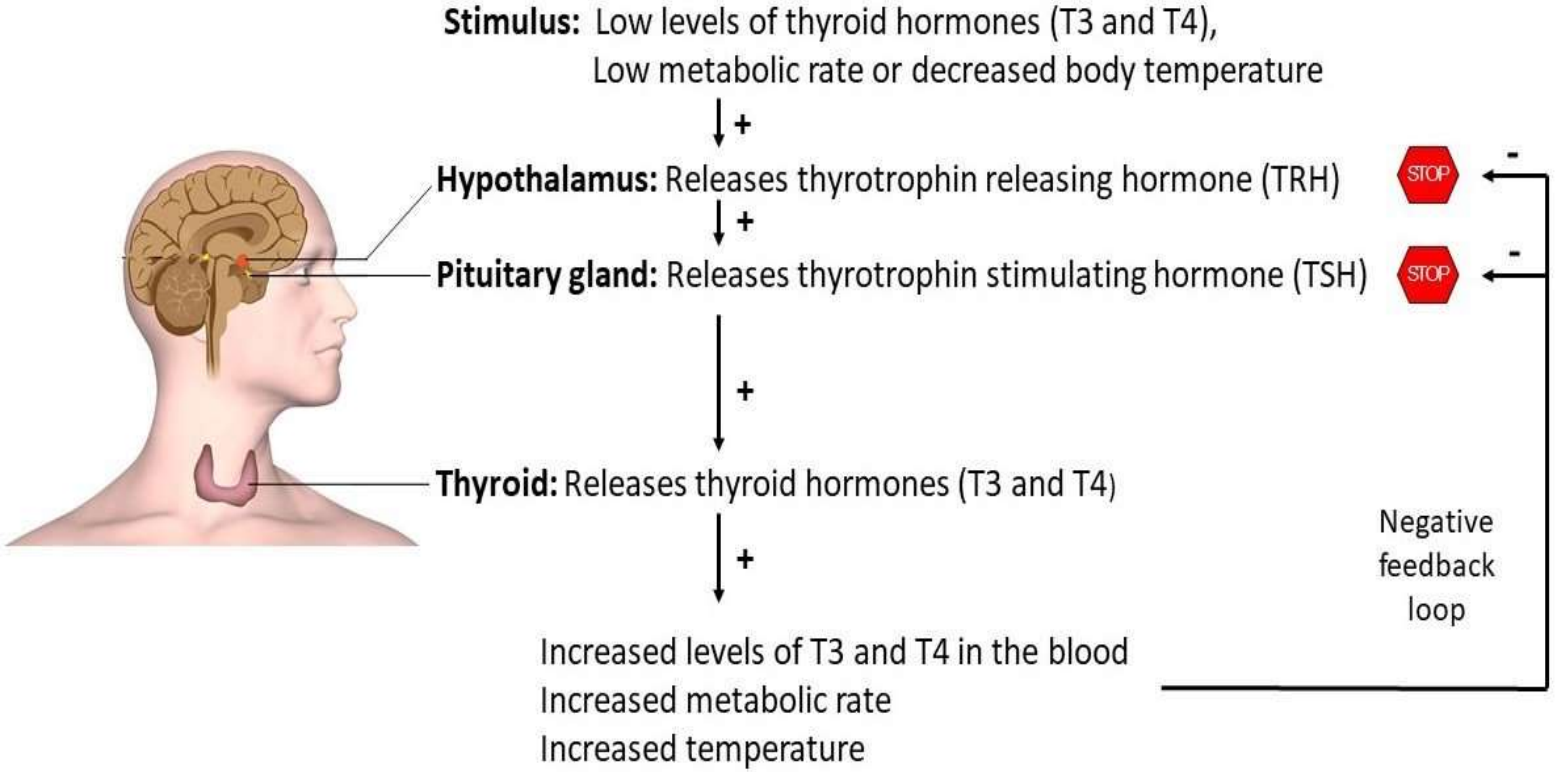


- In general, the nervous system performs corrective management by directing rapid, short-term and very specific response. On the other hand, the endocrine system releases chemical messengers (hormones) that affect tissues and organs throughout the body. The response may be slow to begin with but often persists for days or weeks. However, both system are usually controlled by negative feedback mechanisms.
- **POSITIVE FEEDBACK MECHANISMS**

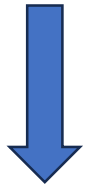
In few instances homeostatic regulation involves Positive feedback mechanisms. i.e. an initial disturbance in a system sets off a chain of events that increases the disturbance even further. Therefore, it does not usually favor stability and often abruptly displaces a system away from its steady state operating point.

Example: Here, the initial stimulus produces response that reinforces (exaggerates) the original stimulus.

- Marked fall in B.P. (stimulus)

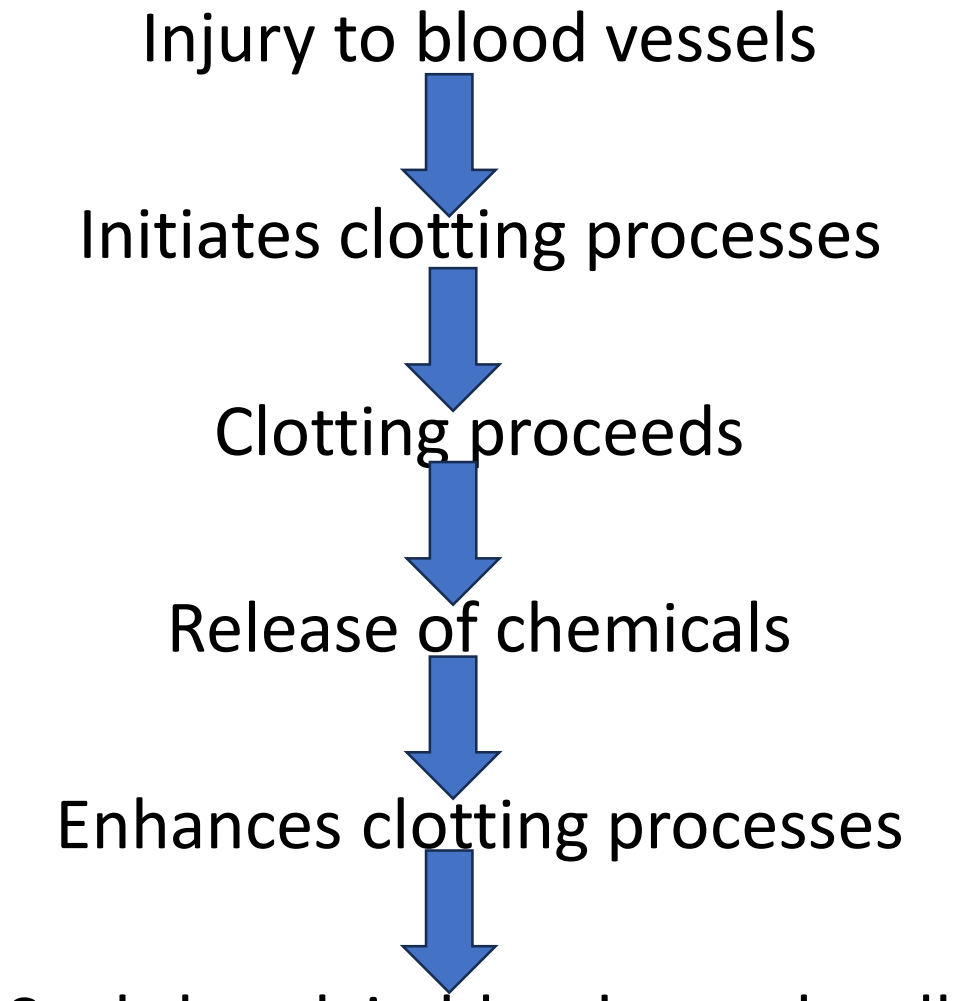
- Decreased blood supply to the heart

- Decrease in myocardial contraction

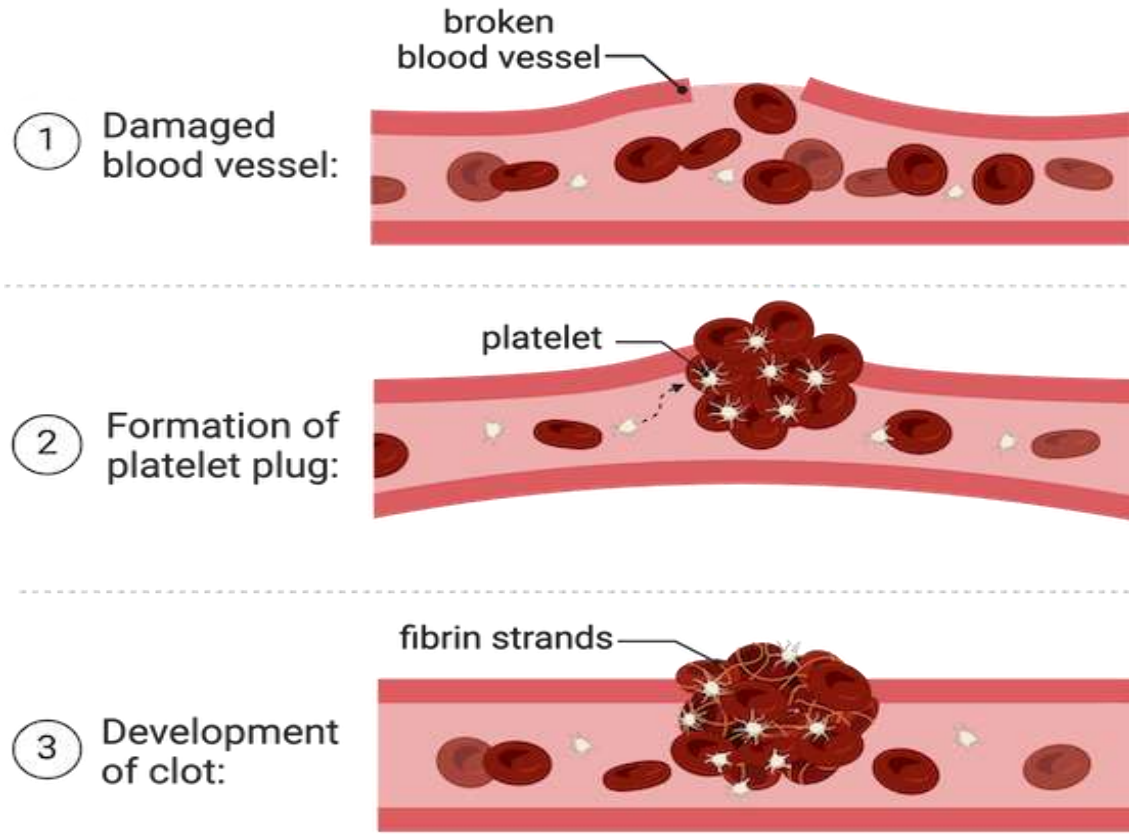


- Further fall in the B. P. (response)

Positive feedback mechanism can sometimes be useful like in case of blood clotting



Blood clotting involves a positive feedback loop.
(1) When a blood vessel is damaged
(2) Platelets near the injury release chemicals to attract more platelets, forming a platelet plug
(3) Fibrin strands are produced and help form a stable blood clot



Revision exercise

- What is homeostasis?
- Which part of the brain regulates body temperature?
- Name one hormone involved in blood sugar regulation.
- What is the normal human body temperature in °C?
- Which organ controls water balance in the body?
- What is the main function of insulin?
- How does the body cool down during exercise?
- Name a waste product removed during exercise.
- What is the role of ADH?
- What happens to breathing rate during exercise?

THANKS