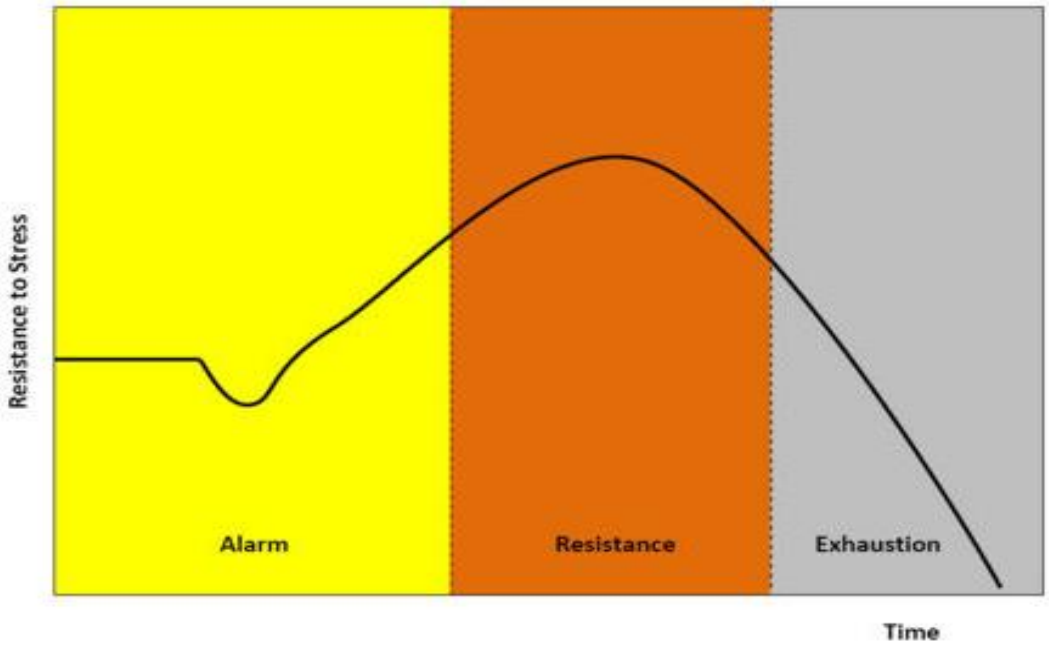
Unit IX – Problem 2 – Physiology: Stress

- **Stress is not always (negative)** → we are born with this reaction which allows us to react with different situations and events.
- **A positive stress which is important and necessary is a short-lived response causing**: ↑ heart rate (HR), ↑ respiratory rate (RR), ↑ cardiac output (CO), ↑ blood pressure (Bp)… etc.
  - **Examples of events in which it is important to have a positive stress response:**
    - ✓ Meeting new people.
    - ✓ Dealing with frustration (الإحباط-خيبة الأمل).
    - ✓ Getting medical procedures (such as injections).
- **Toxic stress**: occurs when the situation or stress is prolonged (examples include: extreme poverty, physical or emotional abuse, chronic serious neglect and family violence). Toxic stress affects children very badly because in early childhood the brain is not well-formed thus if there is a stressful condition this will affect the architecture of the brain resulting in changes in behavior.
- **What are the three physiological systems which are involved in stress?**
  - Nervous system.
  - Endocrine system.
  - Immune system.
- **Neuro-endocrine responses in stress are seen through three main pathways/axes:**
  - **ACTH axis:**
    - ✓ Stress stimulates the release of CRH (Corticotropine Releasing Hormone) from hypothalamus → which in turn will enhance the release of ACTH (Adrenocorticotropic Hormone) from anterior pituitary gland → resulting in release of cortisol (stress hormone) from adrenal cortex.
    - ✓ Effects of crotisol (stress hormone):
      - ❖ *Providing energy to the body:*
        - ➢ Adipose tissue: lipolysis.
        - ➢ Muscle: protein catabolism.
        - ➢ Liver: gluconeogenesis.
      - ❖ *Suppressing immunity and inflammatory responses.*
  - **Vasopressin axis:**
    - ❖ Magnocellular vasopressin from supraoptic (SON) and paraventricular (PVN) nuclei produce and secrete vasopressin to be stored in the posterior pituitary gland (aimed for water-regulation).
    - ❖ Parvocellular neurons of paraventricular nucleus releases vasopressin in portal system to the anterior pituitary gland →to stimulate the release of ACTH (stress-vasopressin axis).
  - **Thyroxin axis (TRH-TSH-thyroxin).**
- **There are three stages of effects associated with stress response:**
  - **Immediate effects:**
    - ✓ Activation of sympathetic nervous system (epinephrine and norepinephrine are released).
  - **Intermediate effects:**
    - ✓ Adrenal response (epinephrine and norepinephrine are released from adrenal medulla).
  - **Prolonged effects:**
    - ✓ ACTH, vasopressin and thyroxin affect different metabolic processes.
- **Other stress-related hormones include:**
  - Serotonin.
  - Melatonin.
  - DHEA (Dehydroepiandrosterone).

- Recent brain researches have shown that cortisol causes irreversible damage/death of brain tissue (especially hippocampal cells).
- **Acute stress characteristics:**
  - Short-term.
  - Quick.
  - Decisive (حازم-قاطع) action required for survival.
- **When there is a stressful situation, there will be release of endorphine** –in addition to epinephrine and norepinephrine- which will suppress pain (e.g. when you get a gunshot you will not feel pain in the beginning because of endorphine release which allows you to take actions and save your life instead of screaming out of pain).
- **What are the changes which will be caused by activation of sympathetic nervous system?**
  - ↑ heart rate (HR).
  - ↑ blood pressure (Bp).
  - ↑ lipid breakdown: which will increase plasma fatty acids and thus providing a source of energy.
  - Peripheral vasoconstriction.
  - Coronary dilation and bronchial dilation.
  - Muscle glycogen will be broken down to glucose (which will be utilized by the muscle itself).
  - Liver glycogen will be broken down to glucose (increasing level of glucose in the blood to provide body with enough energy).
- **Chronic stress(ors):**
  - It is long-term and persistent. Example include: physical, emotional or sexual abuse; poverty; malnourishment; demanding job; depression and anxiety.
  - **General adaptation syndrome:**



  - ✓ Alarm: body initial response with (epinephrine, norepinephrine, endorphin and cortisol) → resulting in activation of sympathetic system, suppression of pain, provision of energy and suppression of immunity.
  - ✓ Resistance: there is continuation of the responses mentioned above and the body is moving to a new (setpoint) that is optimal for stressful conditions (allostasis).
  - ✓ Exhaustion: energy stores are depleted, mayocardium is fatigued, blood vessels are damaged, infections are prevalent and wounds do not heal!