Metabolic Response to Trauma/ P-1

Metabolism

It is the complex system of interrelated biochemical reactions and physiological responses that required for maintaining the life.

Homeostasis:

Homeostasis is an optimum metabolic state that maintains the optimal functioning of the organism

It is a complex process involving the brain, nerves, heart, lungs, kidneys and spleen to maintain body stability.

Stress Response

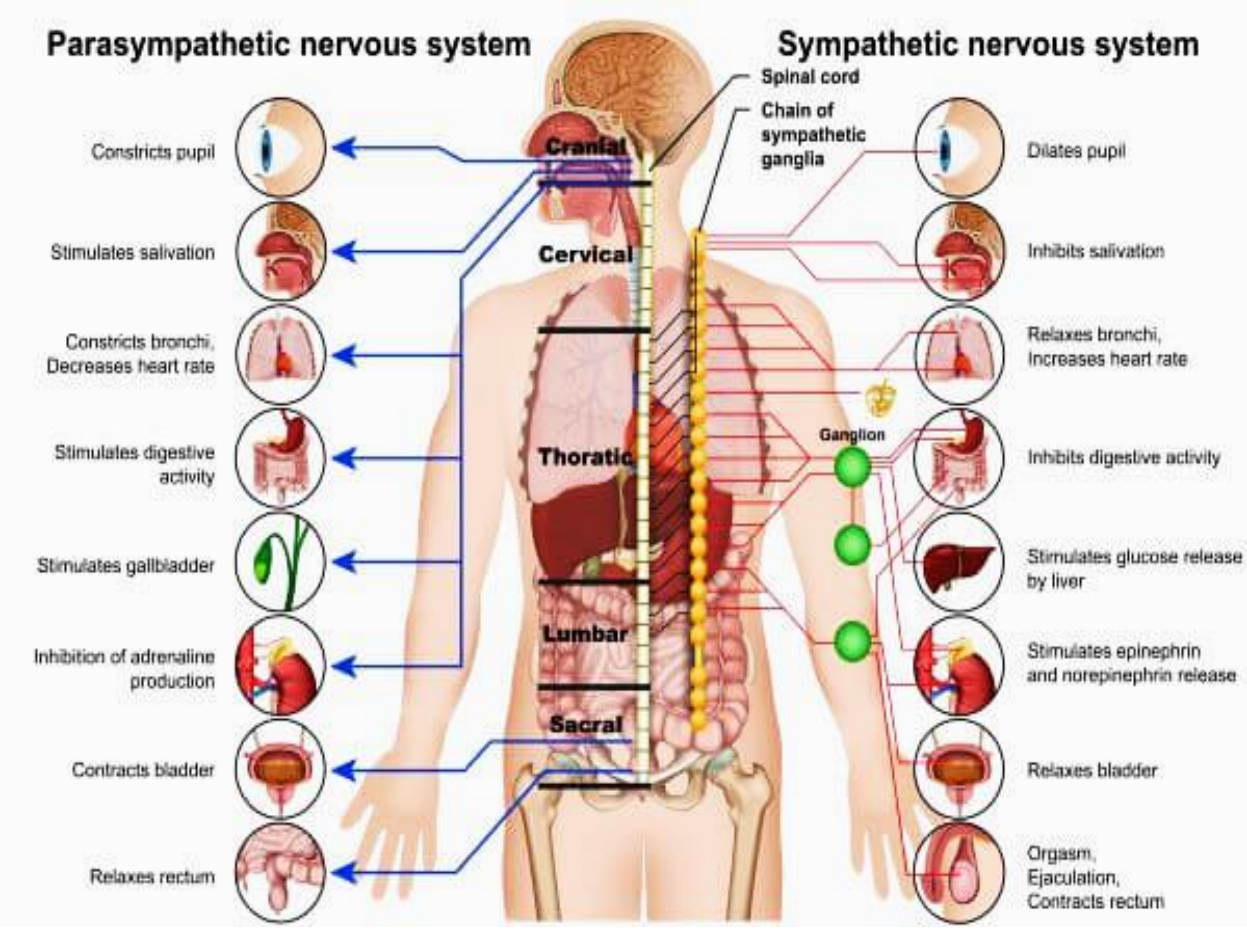
It is the body's damage control system intended to maintain homestasis and to provide substrate for repair of injury.

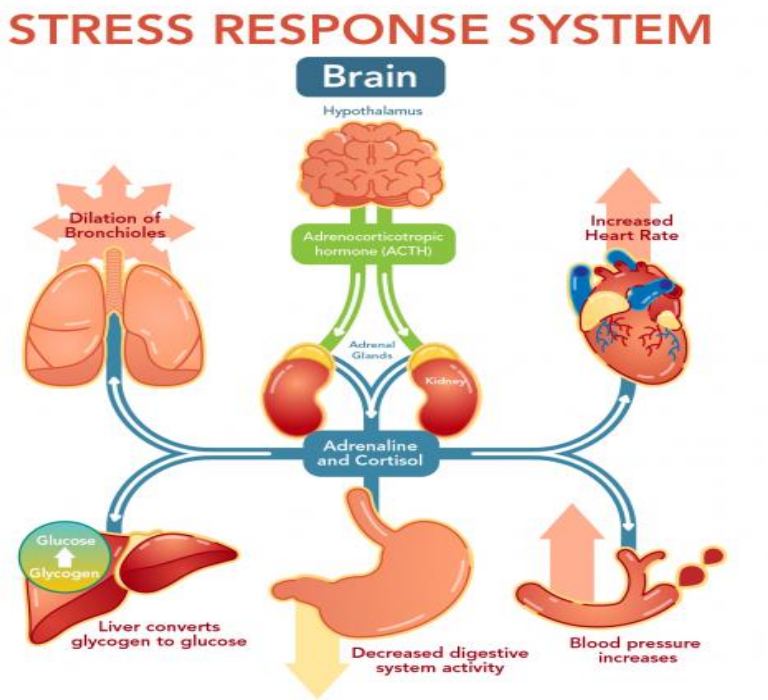
Traumatic injury is one of the many stimuli that trigger a set of metabolic changes known as the stress response.

Other stimuli include: pain, fear, anxiety, hemorrhage, surgery, and infection.

The stress response involves a set of hormonal and inflammatory signals that produces a hypermetabolic state. The hyperglycemia and mobilization of additional energy substrate from muscles and fat stores occur in order to fuel vital body functions.

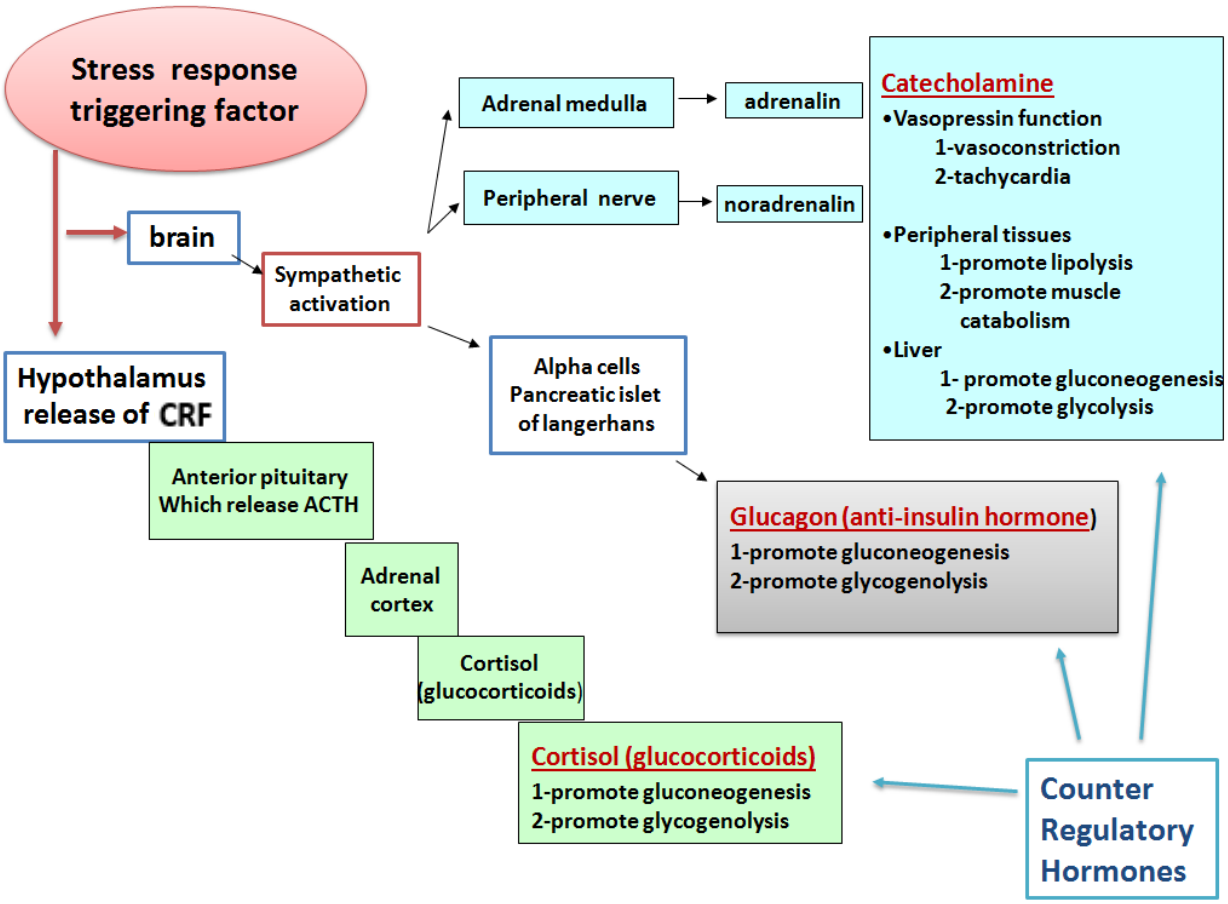
The stress response has two control arms: ***neuroendocrine*** arm and ***inflammatory*** arm

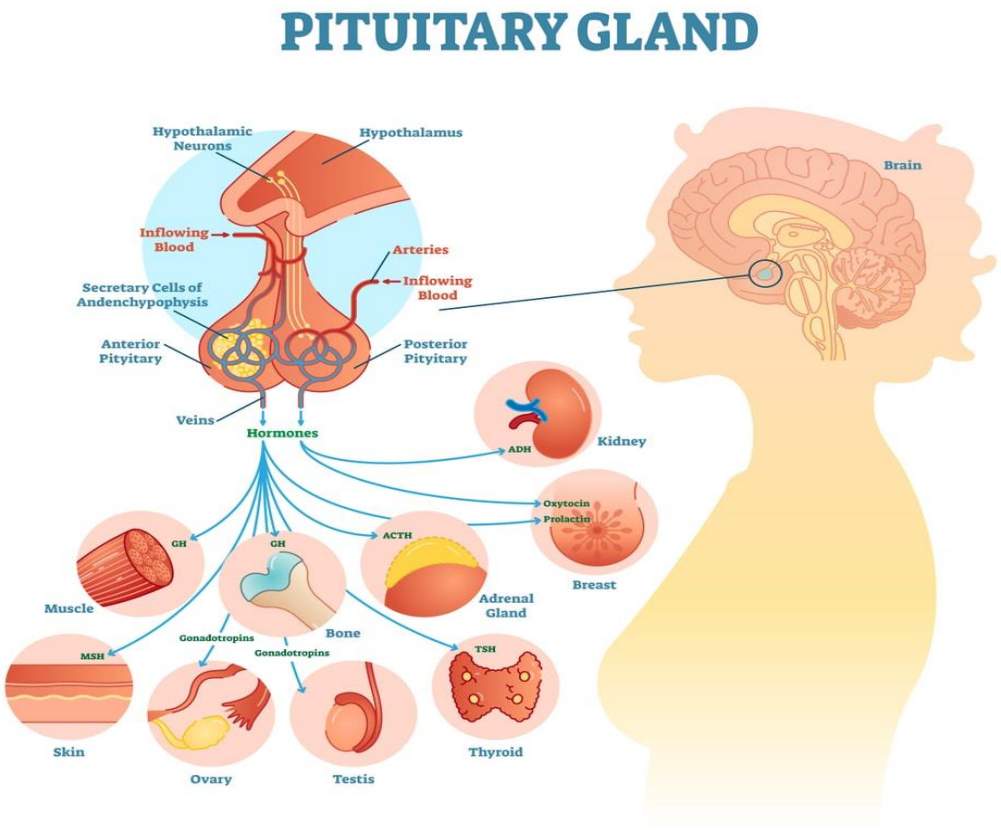

Parasympathetic nervous system
Sympathetic nervous system
Spinal cord
Chain of sympathetic ganglia
Cranial
Cervical
Thoratic
Lumbar
Sacral
Ganglion
Constricts pupil
Stimulates salivation
Constricts bronchi, Decreases heart rate
Stimulates digestive activity
Stimulates gallbladder
Inhibition of adrenaline production
Contracts bladder
Relaxes rectum
Dilates pupil
Inhibits salivation
Relaxes bronchi, Increases heart rate
Inhibits digestive activity
Stimulates glucose release by liver
Stimulates epinephrin and norepinephrin release
Relaxes bladder
Orgasm, Ejaculation, Contracts rectum


STRESS RESPONSE SYSTEM
Brain
Hypothalamus
Adrenocorticotropic hormone (ACTH)
Adrenal Glands
Kidney
Dilation of Bronchioles
Increased Heart Rate
Adrenaline and Cortisol
Glucose
Glycogen
Liver converts glycogen to glucose
Decreased digestive system activity
Blood pressure increases

A-Neuroendocrine arm

- This pathway consists of neural part (Brain, the spinal cord, and afferent neurons) and endocrine part (hypothalamus, pituitary, and adrenal gland).
- Corticotrophin-releasing factor (CRF) released from the hypothalamus increases adrenocorticotrophic hormone (ACTH) release from the anterior pituitary. ACTH then acts on the adrenals to increase the secretion of cortisol.
- Activation of the sympathetic nervous system causes release of adrenaline and also stimulates release of glucagon.
- These 'counter-regulatory' hormones (glucagon, glucocorticoids and catecholamines) have a major role in the metabolic response to injury.





B-Inflammatory arm

- It is mediated by cytokines. which are chemical messengers released by cells, they are produced within the first 24 hours
- The major cytokines identified as components of the inflammatory response are: interleukin-1 (IL-1), tumour necrosis factor alpha (TNFα), IL-6 and IL-8
- These Cytokines:
  - Act directly on the hypothalamus to cause pyrexia.
  - Act directly on skeletal muscle to induce proteolysis.
  - Also play a complex role in the development of peripheral insulin resistance.
- The inflammatory arm (which is controlled by the cytokines) triggers the immunological response to promote haemostasis, wound healing and control of infection.

Systemic Inflammatory Response Syndrome (SIRS)

The pathological extension of the stress response; is known as **Systemic inflammatory response syndrome (SIRS),** which is characterized by exaggerated response of the body and may progress to **Multiple Organ Dysfunction Syndrome (MODS) which may lead to Multiple Organ Failure**

Criteria for SIRS

1. **Body temperature:**

   either > 38 C (due exaggerated response) or < 36 C (due to continuous circulatory volume loss.
2. **Heart rate** > 90 beats per minute (tachycardia)
3. **Respiratory rate** > 20 breath per minute (tachypnea)
4. **White Blood cell count:**

   either > 12,000/ mm^3 (due exaggerated response) or < 4,000/ mm^3 (due to continuous circulatory volume loss.

This is the End of the Lecture – Good Luck