

Emotions, Aggression and Stress (Ch.15) III

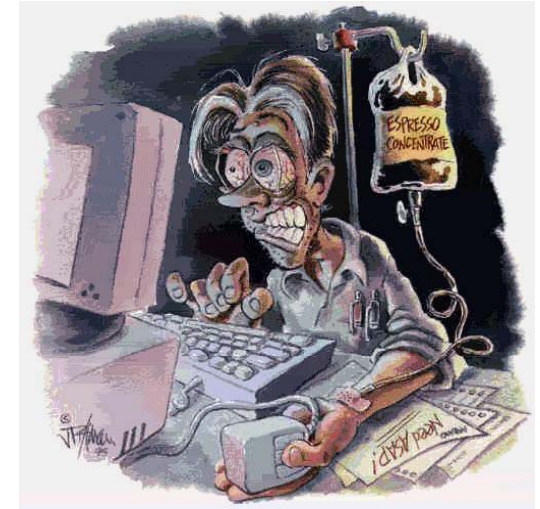
- Neurobiological basis of stress
 - Hypothalamic-pituitary axis
- Effects of acute vs chronic stress
 - Beneficial and detrimental effects

Stress

- Ultimately defined as any change in homeostasis
- Typically broken down into three components
 - Stressful stimulus → processing/assessment of stimulus →

Stress Response (the body's response to emotionally charged events)

- The "stress response" refers to a number of physiological changes (hormonal, neural, behavioural) that are designed to deal with short term problems
- Acute stress can have beneficial effects
 - Designed to enhance the "flight or fight" response
 - Increased energy, metabolism
 - Enhanced attention, vigilance
- However, chronic stress can exert damaging effects on both the brain and immune system
 - **The most damaging type of stress is unpredictable stress**



The Stress Response

Two main pathways out of brain trigger bodily responses to stress

1) *Sympathetic Nervous System*

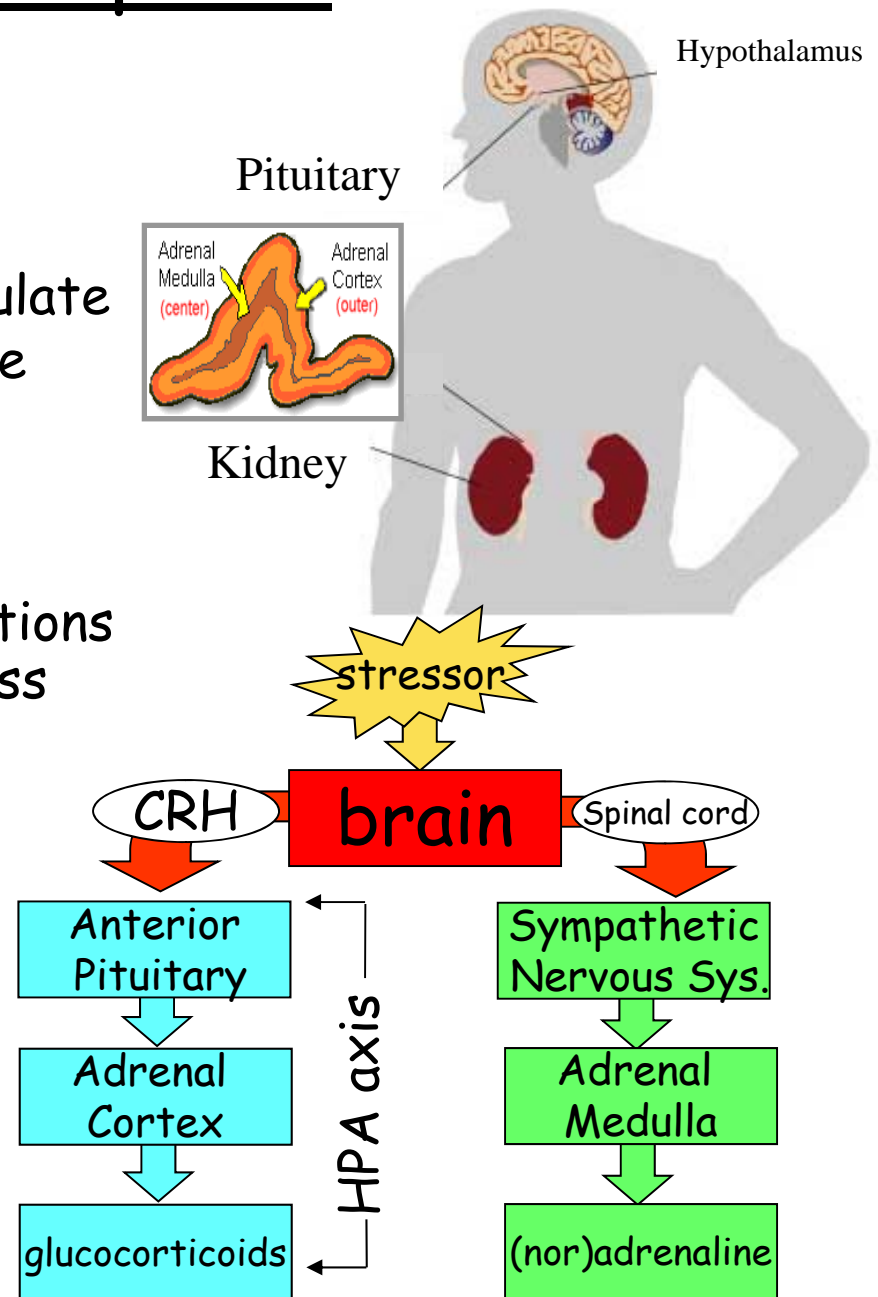
Direct projections from spinal cord stimulate adrenal medulla, causes (nor)adrenaline release

2) *Hypothalamic-pituitary axis (HPA)*

Limbic regions (amygdala, hippocampus, prefrontal cortex) send direct projections to hypothalamus that can trigger stress response

Hypothalamus releases CRH into pituitary, which release ACTH in blood, hits adrenal cortex → glucocorticoid release (CORT)

These hormones ↑ glucose metabolism and ↓ inflammation (get body ready for action and/or damage)



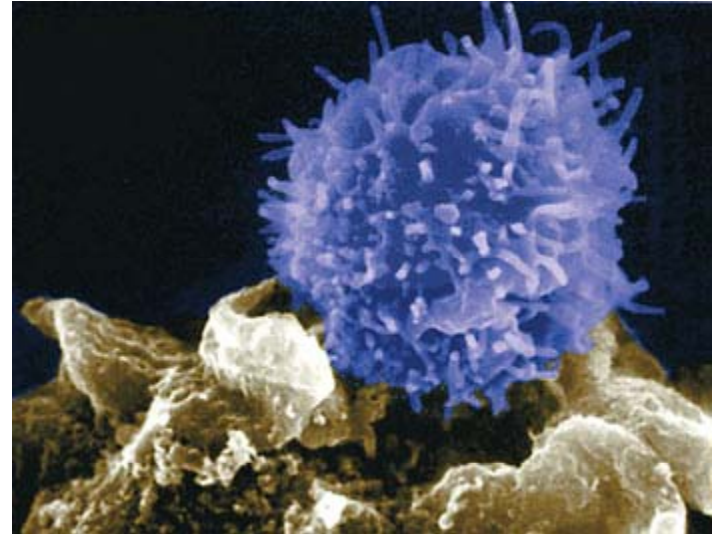
The Stress Response and Consequences of Prolonged Stress

Principal components of the stress response	Common pathological consequences of prolonged stress
Mobilization of energy at the cost of energy storage	Fatigue, muscle wasting, steroid diabetes
Increased cardiovascular and cardiopulmonary tone	Hypertension (high blood pressure)
Suppression of digestion	Ulcers
Suppression of growth	Psychogenic dwarfism, bone decalcification
Suppression of reproduction	Suppression of ovulation, impotency, loss of libido
Suppression of immunity and of inflammatory response	Impaired disease resistance
Analgesia	Apathy
Neural responses, including altered cognition and sensory thresholds	Accelerated neural degeneration during aging

- Acute stress can be beneficial
- Chronic stress has detrimental effects
 - (our bodies were not designed to deal with this type of stress)

Stress and Immunity

- Immune response: stimulation of different cells, release of certain hormones designed to fight infection
- The CNS influences the responses of the immune system and vice versa
 - Hypothalamus can monitor levels of immunity proteins in blood
 - Autonomic nervous system provides inputs to immune organs
 - B lymphocytes (B cells)=produces antibodies that neutralize pathogens
 - T lymphocytes (T cells)=act as killer cells
- HPA system suppresses the immune response
 - **Chronic stress reduces circulating levels of both types of cells in animals and humans**
 - Stressor can be severe (maternal separation, electric shock etc.) or somewhat mild (final exam stress)
 - Ulcers associated with chronic stress are actually due to a bacteria present in most people (*Helicobacter pylori*); many people have it, but stress reduces immune response, allows it to cause ulcers



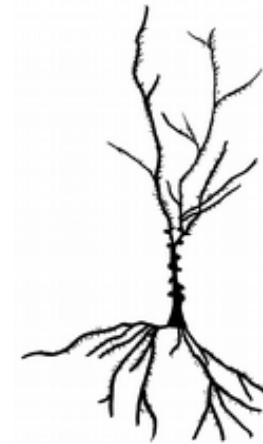
Stress and Cognition

- Acute stress (or just *CORT*) can enhance function of memory centers like the hippocampus
 - Lots of *CORT* receptors on hippocampal neurons
 - *CORT* can increase excitability of these neurons; lead to better memory encoding
 - Acute stressors can enhance many types of cognitive function (memory encoding and retrieval, attention, short term memory etc).
 - Part of the cognitive-enhancing effects of acute stress are due to increased release of monoamines (dopamine, noradrenaline).
- Chronic stress (and chronic increases in *CORT*) can lead to death of hippocampal neurons
 - Chronic stress can impair memory formation
 - Chronic injections of *CORT* alone (without stressor) can also lead to neuronal atrophy/cell death and memory impairments in animals
 - Excessive monoamine release in brain can also impair cognitive functioning (too much of a good thing).

Hippocampal neurons



control



Chronically-stressed

Stress and Testosterone

- One prominent effect of increased CORT release is decrease testosterone levels
 - Parachute training experiment
 - Effect on testosterone disappears over time (predictable stress not as detrimental)
 - ↓ testosterone adaptive because it reduces energy usage mediated by testosterone (muscle building, sperm production, libido etc.)
- Social stress: chronic stressor common in primates
 - Subordinate males typically have higher CORT levels, lower testosterone levels, shorter lifespans
 - Dominant males do not necessarily have higher levels of testosterone, but do show faster recovery of testosterone levels after stressor (vs subordinates)
 - Repeated social stressors (fights) can lead to long term reductions/increases in testosterone in losers/winners
 - Even more subtle social stressors (e.g.: giving a talk) induces large CORT₇ release in humans

