



Stress and Disease

Dr. Gary Mumaugh



Stress

- A person experiences stress when a demand exceeds a person's coping abilities, resulting in reactions such as disturbances of cognition, emotion, and behavior that can adversely affect well-being



Dr. Hans Selye

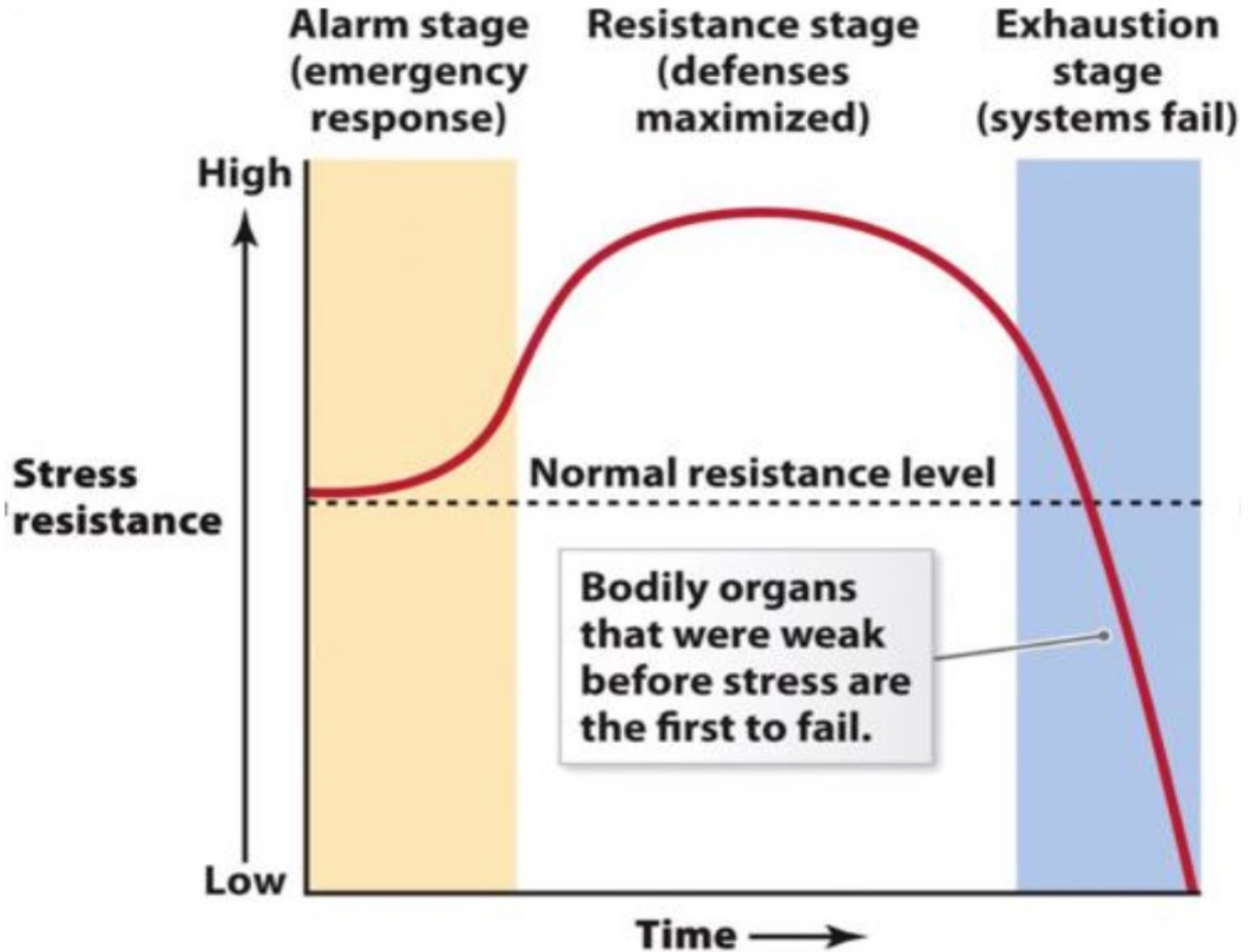
- Worked to discover a new sex hormone
- Injected ovarian extracts into rats
- Witnessed structural changes
 - Enlargement of the adrenal gland
 - Thymic and other lymphoid structure atrophy
 - Development of bleeding ulcers in the stomach and duodenal lining



Dr. Hans Selye

- Dr. Selye witnessed these changes with many agents. He called these stimuli “stressors.”





General Adaptation Syndrome (GAS)

- Three stages
 - Alarm stage
 - Arousal of body defenses
 - Stage of resistance or adaptation
 - Mobilization contributes to fight or flight
 - Stage of exhaustion
 - Progressive breakdown of compensatory mechanisms
 - Onset of disease



GAS Activation

- Alarm stage
 - Stressor triggers the hypothalamic-pituitary-adrenal (HPA) axis
 - Activates sympathetic nervous system
- Resistance stage
 - Begins with the actions of adrenal hormones
- Exhaustion stage
 - Occurs only if stress continues and adaptation is not successful



Stress Response

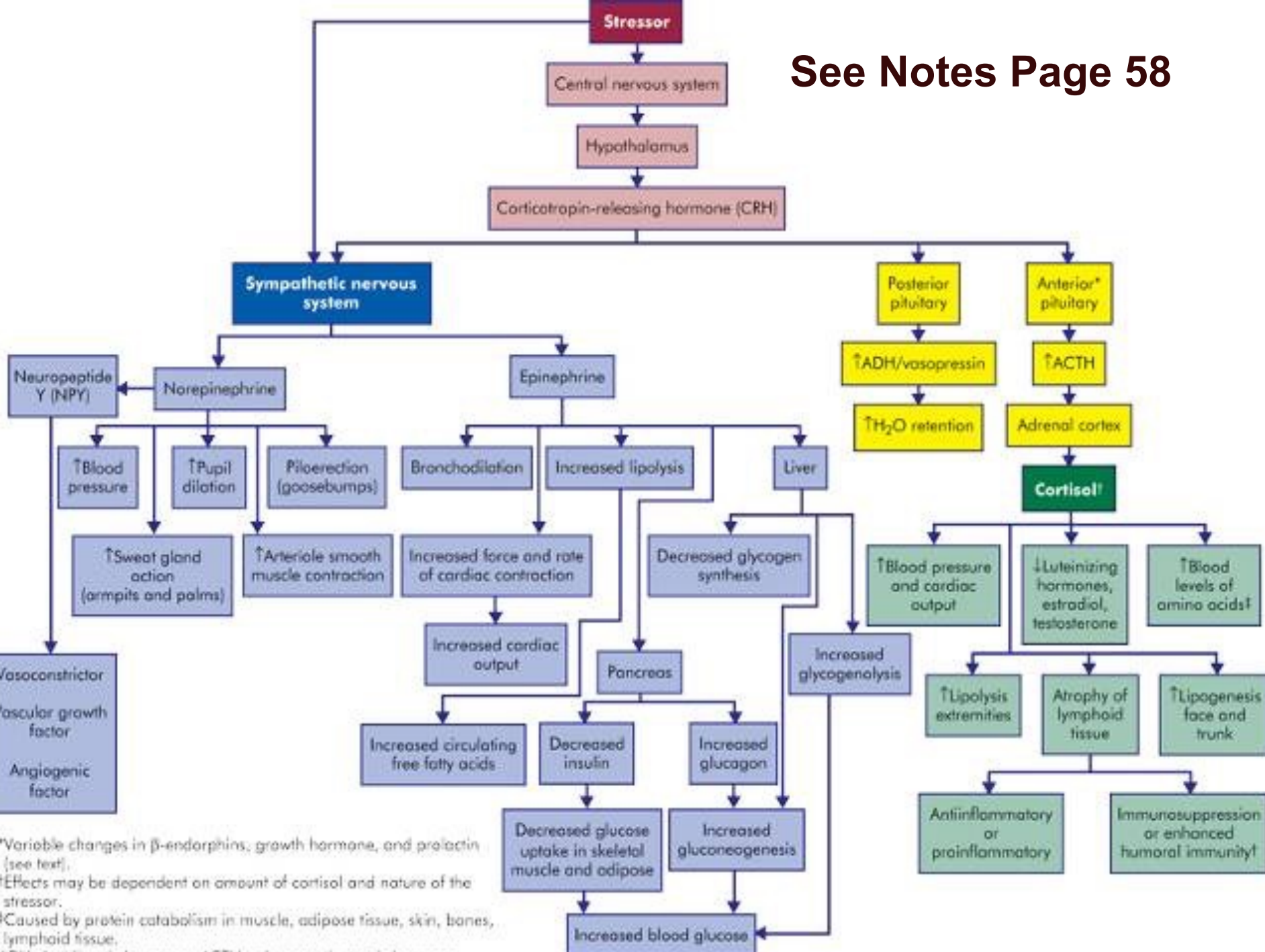
- Nervous system
- Endocrine system
- Immune system



Psychologic Mediators and Specificity

- Reactive response
- Anticipatory response
- Conditional response





*Variable changes in β -endorphins, growth hormone, and prolactin (see text).

†Effects may be dependent on amount of cortisol and nature of the stressor.

‡Caused by protein catabolism in muscle, adipose tissue, skin, bones, lymphoid tissue.

ADH, Antidiuretic hormone; ACTH, adrenocorticotropic hormone.

Psychoneuroimmunologic Regulation

- Interactions of consciousness, the brain and spinal cord, and the body's defense mechanisms
- Immune modulation by psychosocial stressors leads directly to health outcomes
- Corticotropin-releasing hormone (CRH) is released from the hypothalamus



Neuroendocrine Regulation

- Catecholamines
 - Released from chromaffin cells of the adrenal medulla
 - Epinephrine released
 - α -adrenergic receptors
 - β -adrenergic receptors
 - Mimic direct sympathetic stimulation



Neuroendocrine Regulation

- Cortisol (hydrocortisone)
 - Activated by adrenocorticotrophic hormone (ACTH)
 - Stimulates gluconeogenesis
 - Elevates the blood glucose level
 - Powerful anti-inflammatory and immunosuppressive agent



Cortisol and Immune System

- Glucocorticoids and catecholamines
 - Decrease cellular immunity while increasing humoral immunity
 - Increase acute inflammation



Stress-Induced Hormone Alterations

- β -Endorphins
 - Proteins found in the brain that have pain-relieving capabilities
 - Released in response to stressor
 - Inflamed tissue activates endorphin receptors
 - Hemorrhage increases levels, which inhibits blood pressure increases and delay compensatory changes



Stress-Induced Hormone Alterations

- Growth hormone (somatotropin)
 - Produced by the anterior pituitary and by lymphocytes and mononuclear phagocytic cells
 - Affects protein, lipid, and carbohydrate metabolism and counters the effects of insulin
 - Enhances immune function
 - Chronic stress decreases growth hormone



Stress-Induced Hormone Alterations

- Prolactin
 - Released from the anterior pituitary
 - Necessary for lactation and breast development
 - Prolactin levels in the plasma increase as a result of stressful stimuli



Stress-Induced Hormone Alterations

- Oxytocin
 - Produced by the hypothalamus during childbirth and lactation
 - Produced during orgasm in both sexes
 - May promote reduced anxiety



Stress-Induced Hormone Alterations

- Testosterone
 - Secreted by Leydig cells in testes
 - Regulates male secondary sex characteristics and libido
 - Testosterone levels decrease because of stressful stimuli
 - Exhibits immunosuppressive activity



Role of Immune System

- Stress directly related to proinflammatory cytokines
- Link between stress, immune function, and disease
- Immune system affected by neuroendocrine factors
- Stress response decreases T cell cytotoxicity and B cell function



Stress, Personality, Coping, and Illness

- A stressor for one person may not be a stressor for another
- Psychologic distress
 - General state of unpleasant arousal after life events that manifests as physiologic, emotional, cognitive, and behavior changes



Aging and Stress

- Stress-age syndrome
 - Excitability changes in the limbic system and hypothalamus
 - Increased catecholamines, ADH, ACTH, and cortisol
 - Decreased testosterone, thyroxine, and other hormones
 - Alterations of opioid peptides



Aging and Stress

- Immunodepression
- Alterations in lipoproteins
- Hypercoagulation of the blood
- Free radical damage of cells

