

Oxytocin (OT)

Functions

- Stimulates Uterine Contraction
- Stimulates release of milk from lactating breast
- Facilitates sperm transport in the male reproductive tract
- Plays a role in bonding (“love hormone”)

Inhibited By :

- None

Stimulated By :

- Dilation of cervix
- Distension of uterus
- Suckling of breasts
- Intimacy

Hyposecretion Effects:

- Difficulty with birthing and lactation
- Decreased sperm transport in male reproductive tract

Hypersecretion Effects:

- None

Antidiuretic Hormone (ADH) Vasopressin

Functions

- Regulates blood osmolarity (most important function)
 - Regulates transport of water into the blood by kidneys
 - Osmolarity Normal Range = 280 - 300
- Regulates blood pressure (minor function)
 - Regulates transport of water into the blood by kidneys
 - Regulates blood vessel tone

Inhibited By :

- Low blood osmolarity
- High blood volume
- High blood pressure

Stimulated By :

- High blood osmolarity
- Low blood volume /
- Low blood pressure
- Stress

Hyposecretion Effects:

- Diabetes Insipidus
 - Small volume of water is transported into blood
 - Large increase in blood osmolarity
 - Large decrease in blood volume / blood pressure

Hypersecretion Effects:

- Syndrome of Inappropriate ADH (SIADH)
- Large volume of water transported into blood
- Large decrease in blood osmolarity
- Large increase in blood volume / blood pressure

Luteinizing Hormone (LH)

Functions

- Stimulates testosterone production
 - Indirectly stimulates sperm production
- Helps regulate the menstrual cycle

Inhibited By :

- Low GnRH
- High blood testosterone
- Stress
 - (via inhibition of GnRH)

Stimulated By :

- GnRH
- Low blood testosterone

Hyposecretion Effects:

- Low blood testosterone
 - (decreases sperm production)
- Decreased libido
- Erectile Dysfunction
- Amenorrhea

Hypersecretion Effects:

- High blood testosterone
- Amenorrhea
 - (lack of a menstrual cycle)

Follicle Stimulating Hormone (FSH)

Functions

- Stimulates sperm production
- Stimulates estrogen production
- Helps regulate the menstrual cycle

Inhibited By :

- High blood estrogen
- Inhibin (hormone released from testes and ovaries)
- Low GnRH
- Stress (via inhibition of GnRH)

Stimulated By :

- GnRH
- Low blood estrogen
 - (females)
- Low blood testosterone
 - (males)

Hyposecretion Effects:

- Low blood Estrogen
- Amenorrhea
- Decrease in sperm production

Hypersecretion Effects:

- High blood estrogen
- Amenorrhea

Prolactin (PRL)

Functions

- Stimulates milk production in lactating females
- Stimulates breast development
- Modulates the production of testosterone in males and thus sperm production

Inhibited By :

- PIH
 - (continually inhibits prolactin)

Stimulated By :

- Estrogen
- Suckling of breasts
- Decreased levels of PIH

Hyposecretion Effects:

- Females = lack of milk production during lactation
- Males = None

Hypersecretion Effects:

- Inhibits GnRH (effects via LH and FSH)
 - Low estrogen
 - Amenorrhea (lactational)
 - Low testosterone
 - Decreased sperm production
 - Decreased libido
 - Erectile dysfunction
- Galactorrhea (spontaneous milk production)

Growth Hormone (GH)

Functions

- Stimulates and regulates growth and repair of tissues
- Stimulates amino acid uptake and their synthesis into proteins
- Increases blood fatty acids via lipolysis
- Increases blood glucose via gluconeogenesis

Inhibited By :

- GHIH
- High blood glucose (hyperglycemia)
- Low blood amino acids
- High blood fatty acids
- Sleep-awake transition (lowest level shortly before waking)

Stimulated By :

- GHRH
- Deep sleep (highest level during deep sleep)
- Low blood glucose (hypoglycemia)
- High blood amino acids (especially arginine)
- Low blood fatty acids
- Stress
- Exercise

Hyposecretion Effects:

- Pituitary Dwarfism
 - Decreased growth hormone level during childhood
 - Proportional but small in stature
 - Can treat with human growth hormone
 - Must be done prior to growth plate ossifying
 - Accounts for approximately 30% of dwarfism
 - Other 70% is due to achondroplastic dwarfism
 - Growth plate problem. Growth hormone levels are normal

Hypersecretion Effects:

- Abnormal lengthening and thickening of bones
- Abnormal organ growth (can lead to organ failure)
- Elevated blood fatty acids (can lead to cardiovascular disease)
- Elevated blood glucose (can lead to type 2 diabetes mellitus)
- Caused by (often due to benign tumor of the anterior pituitary)
 - Pituitary gigantism / giantism
 - Elevated growth hormone during childhood
 - Acromegaly
 - Elevated growth hormone after puberty

Thyroid Stimulating Hormone (TSH)

Functions

- Stimulates thyroid hormones (thyroxine and triiodothyronine

Inhibited By :

- Low TRH
- High thyroxine
- High triiodothyronine
- Stress

Stimulated By :

- TRH
- Low thyroxine
- Low triiodothyronine

Hyposecretion Effects:

- Decreased levels of thyroxine and triiodothyronine

Hypersecretion Effects:

- Increased levels of thyroxine and triiodothyronine

Adrenocorticotrophic Hormone (ACTH)

Functions

- Stimulates all adrenal cortex hormones
 - (especially cortisol)
- Stimulates melanocytes

Inhibited By :

- Low CRH level
- Deep sleep (lowest levels during deep sleep)
- High aldosterone , high cortisol , high DHEA

Stimulated By :

- CRH
- Inflammation
- Stress
- Hypoglycemia
- Sleep-wake transition (highest level just before waking)
- Low aldosterone , low cortisol , low DHEA

Hyposecretion Effects:

- Low level of adrenal cortex hormones (especially cortisol)

Hypersecretion Effects:

- High level of adrenal cortex hormones (especially cortisol)
- Darkened skin

Thyroxine and Triiodothyronine (T_3 and T_4)

Functions

- Regulate metabolism
- Help regulate body temperature (via metabolic regulation)
- Protein synthesis
- Glucose synthesis via gluconeogenesis and glycogenolysis
- Decrease plasma cholesterol

Inhibited By :

- Decreased levels of TSH
- Decreased blood iodine
- Hyperglycemia
- Stress (via inhibition of TSH)

Stimulated By :

- TSH / Thyrotropin
- Increased blood iodine
- Hypoglycemia
- Cold

Thyroxine and Triiodothyronine (T₃ and T₄)

Hyposecretion Effects:

- Cold Intolerance
- Dry skin and hair
- Increased plasma cholesterol
- Low heart rate
- Decreased ventilation
- Lethargy
- Constipation
- Goiter if due to primary hypothyroidism
 - Causes an increase in TSH
 - Causes thyroid gland to enlarge

Caused By :

- **Primary** hypothyroidism (~ 90% of cases)
 - Inability of thyroid gland to produce T₃ and T₄
 - Congenital errors in T₃ and T₄ synthesis
 - Iodine deficiency
 - Can lead to cretinism in unborn infants
 - Can lead to goiter
 - (it just stores and accumulates without iodine)
 - Hashimoto's Disease
 - Primary autoimmune , produces antibodies that destroy the thyroid gland
- **Secondary** hypothyroidism
 - Decreased TRH or TSH
 - Also causes thyroid gland to atrophy

Thyroxine and Triiodothyronine (T_3 and T_4)

Hypersecretion Effects:

- Excess sweating
- Heat intolerance
- Weight loss
- High heart rate
- Increased ventilation
- Nervousness
- Diarrhea
- Exophthalmos (protruding of the eyes)
 - Mucoprotein and fluid deposition behind the eye
- Goiter

Caused By :

- Grave's Disease
 - Autoantibodies are produced that mimic TSH
 - Agonist of the TSH receptors
 - Secondary hypothyroidism disease
- Pituitary Tumor
 - Increased TSH
- Thyroid Tumor
 - (almost always causes hypersecretion)

Calcitonin

Functions

- Thyroid hormone not involved with metabolism
- Produced by parafollicular cells / extrafollicular cells
- Function is unclear based on physiological levels

Parathyroid Hormone (PTH)

Functions

- Regulates blood calcium and blood phosphate
- Regulates release of calcium from bones
- Regulates reabsorption of calcium by kidneys
- Regulates conversion of vitamin D3 in the kidneys
 - Calcidiol into calcitriol
 - Aid in absorption of calcium in the gut
- Regulates release of phosphate from bones
- Regulates secretion of phosphate by kidneys

Hyposecretion Effects:

- Low blood calcium (hypocalcemia)
 - Seizures
 - Muscle spasms
- Caused by :
 - Accidental removal during thyroidectomy
 - Autoimmune
 - Tumor
 - Congenital
 - Idiopathic

Inhibited By :

- High blood calcium
- Low blood phosphate

Stimulated By :

- Low blood calcium
- High blood phosphate

Hypersecretion Effects:

- Overstimulation of osteoclasts leading to osteoporosis
- High blood calcium (hypercalcemia)
- Muscle weakness
- Lethargy
- High blood pressure
- Caused by :
 - Primary hyperparathyroidism
 - Approximately 90% caused by tumor
 - Approximately 10% are idiopathic
 - ~~Secondary hyperparathyroidism~~
 - ~~Caused by conditions that reduce blood calcium~~
 - ~~Leads to release of parathyroid hormone~~
 - ~~Eg , inadequate dietary intake of calcium~~
 - ~~Eg , inadequate levels of vitamin D3~~

Mineralocorticoids (Aldosterone)

Functions

- Regulates blood pressure
- Regulates Na⁺ transport into blood by kidneys
- Water follows Na⁺ osmotically
- Regulates transport of K⁺ out of the blood by kidneys
- Regulates transport of H⁺ out of the blood by kidneys

Hyposecretion Effects:

- Low blood pressure / blood volume
- Hyponatremia
- Hyperkalemia
- Low blood pH (acidosis)
- Caused by :
 - Addison's disease
 - Autoimmune destruction of adrenal cortex

Inhibited By :

- Increased blood pressure
- Increased blood volume
- High blood sodium
 - (hypernatremia)

Hypersecretion Effects:

- High blood pressure / blood volume
- Hypernatremia
- Low blood potassium (hypokalemia)
- High blood pH (alkalosis)
- Caused by :
 - Primary aldosteronism
 - Conn's syndrome
 - Caused by adrenal cortex tumor
 - Low renin due to negative feedback
 - Secondary aldosteronism
 - Caused by increase in renin production
 - Can also be caused by increased ACTH
 - Could lead to darkened skin

Stimulated By :

- Renin (an enzyme) is released from the kidneys
- Renin converts angiotensinogen not angiotensin 1
 - Angiotensin 1 converted into angiotensin 2
 - Angiotensin 2 stimulates aldosterone
- Renin released in response to :
 - Decreased blood pressure / blood volume
 - Low blood sodium (hyponatremia)
 - High blood potassium (hyperkalemia)
- Stress (solely psychological)
- ACTH (minor role)

Glucocorticoids (Cortisol)

Functions

- Anti-inflammatory
 - Inhibits series 2 prostaglandins
 - Decreases number of white blood cells
 - Inhibits release of histamine from mast cells
- Maintenance of blood vessel tone
- Increases blood glucose via gluconeogenesis
 - Glucose made from amino acids
 - Cortisol stimulates protein catabolism
- Helps the body deal with stress

Hyposecretion Effects:

- Inability to deal with stress (life threatening)
- Caused by :
 - Primary adrenal insufficiency
 - Destruction of zona fasciculata due to Addison's
 - Results in high blood ACTH
 - Negative feedback from low cortisol
 - Could have darkened skin
 - Secondary adrenal insufficiency
 - Inadequate secretion of ACTH

Inhibited By :

- Deep sleep
- Low ACTH

Hypersecretion Effects:

- Hyperglycemia (adrenal diabetes : Type 2 diabetes)
- Increased production of fat from excess glucose
 - Mainly in face ("moon face") and trunk ("buffalo hump")
- Muscle wasting (from loss of protein)
- Thinning of skin (from loss of protein ... collagen)
 - Blood vessels become more prominent in appearance
 - Face appears red and striae seen mainly on abdomen
- Edema (from loss of protein in blood causing hypotonicity
- High blood pressure
- Frequent infection (immune system depressed)
- Caused by :
 - Cushing's Syndrome
 - Due to adrenal tumor
 - Due to prolonged corticosteroid use
 - Results in low blood ACTH
 - Negative feedback from high cortisol
 - Cushing's Disease
 - Caused by elevated ACTH
 - Negative feedback from high cortisol

Stimulated By :

- Stress
- Inflammation
- Low blood glucose
- Sleep-wake transition
- ACTH

Androgens

Functions

- Dehydroepiandrosterone (DHEA)
 - Main androgen released
 - Converted to testosterone in males and females
 - Converted to estrogen in females
- Androstenedione
 - Converted to testosterone
- Effects masked in males by high testosterone levels
- Effects are only significant in females
 - Plays a large role in libido

Hyposecretion Effects:

- Decreased libido in females

Inhibited By :

- Low blood ACTH

Stimulated By :

- ACTH

Hypersecretion Effects:

- Masculinizing effects in females
- Increased libido in females
- Early secondary sex characteristics in males
- Short stature if it occurs prior to puberty
- Ambiguous genitalia in females if it occurs prior to birth
- Caused by :
 - Adrenogenital syndrome
 - Caused by inability to produce cortisol and aldosterone
 - Increased ACTH release via negative feedback
 - Leads to increased levels of androgens

Insulin

Functions

- Regulates blood glucose (main function)
 - Regulates cellular glucose transport from the blood
 - Decreases blood glucose
- Regulates cellular transport of fatty acids from the blood
 - Increases lipogenesis
- Regulates cellular transport of amino acids from the blood
 - Increases protein synthesis

Hyposecretion Effects:

- Due to type 1 diabetes mellitus (~ 5 % of cases)
 - Autoimmune destruction of beta cells (insulin not produced)
 - Also known as insulin-dependent diabetes mellitus
 - Must take insulin daily (treatment)

Inhibited By :

- Low blood glucose
- Low blood fatty acids
- Low blood amino acids
- Stress

Hypersecretion Effects:

- Low blood glucose (hypoglycemia)
 - Can lead to coma ("diabetic coma")
- Excess fat production and storage
- Increase in protein production
- Can lead to type 2 diabetes mellitus (~ 95% of cases)
 - Poor lifestyle is usually (but not always) to blame
 - Constant insulin hypersecretion leads to insulin resistance
 - Insulin Resistance
 - Blood glucose regulation is lost
 - Leads to elevated blood glucose
 - Insulin production is usually fine (can decrease in later stages)
 - Type 2 diabetes is manageable with positive change in lifestyle
 - Meds (eg , metformin , insulin) might also be needed.

Stimulated By :

- High blood glucose (main stimulus)
- High blood fatty acids
- High blood amino acids
- Glucose-dependent insulinotropic peptide

Glucagon

Functions

- Raises blood glucose via gluconeogenesis and glycogenolysis
- Raises blood fatty acids via lipolysis
- Released by alpha islets of Langerhan cells (~ 30% of cells)

Inhibited By :

- High blood pressure

Stimulated By :

- Low blood glucose (main stimulus)
- Increased blood amino acids
 - Used for gluconeogenesis
- Sympathetics

Hyposecretion Effects:

- Low blood glucose
 - (however , other hormones can raise blood glucose)

Hypersecretion Effects:

- High blood glucose