Physiologic effects of mineralocorticoids pineal gland biology essay

Science, Biology

Released: MelatoninFunction: Regulates the body’s internal clock respondingto light and dark as well as sleep/wake rhythms. Melatonin can also have an inhibitory effect on the sexual glands by decreasing simulation of these organs by the brainD) ThyroidReleased: Thyroxine (T4) and triiodothyronine (T3)Function: Regulates growth and development. They also help maintain our body’s core temperature and metabolic levels(http://www. medadvocate. net/complimentary/ThyroidFunctionOverview. pdf, 2009)Released: CalcitoninFunction: Decreases rate of bone breakdown, It also prevents large increase in bloodcalcium levelsE) ParathyroidsReleases: Parathyroid (PTH)Function: Increases rate of bone breakdown byosteoclasts; increases vitamin Dsynthesis, essential formaintenance of normal bloodcalcium levelscontinuedF)ThymusRelease: ThymosimFunction: helps in the development of certain white blood cells, called T cells. T cells help protect the body against infectionby foreign organisms. The thymus gland is most importantearly in life, becoming smaller in the adult. G) Adrenal cortex: Released: Glucocorticoids (cortisol)Function: Raise blood glucose level; stimulate breakdown of protein, and increases blood concentration of amino acids. It also promotes the release of fatty acids from adipose tissue. Released: Mineralocorticoids (aldosterone)Function: stimulates the exchange of sodium and potassium by reabsorbing sodium and excreting potassiumReleased: Sex hormonesFunction: Stimulate reproductive organs and bring about sex characteristicsAdrenal medulla: Released: Epinephrine and norepinephrineFunction: in situations of fear or stress Epinephrine and norepinephrine can be released this causes an Increase in heart rate, widening of blood vessels (increasing blood flow), widening of bronchi and a

breakdown of glycogen to glucose, this in turn raises the blood sugar level. Metabolic rate also increasesH) Pancreas: Released: InsulinFunction: secreted by the beta cells of the pancreas in situations of high blood sugar. It allows muscles, red blood cells and fat to take in excess glucose from the blood, Lowering blood glucose levels. It also promotes formation of glycogenReleased: GlucagonFunction: if the blood sugar level in the body is low glucagon is released from the alpha cells in the pancreas, causing the liver to release stored glucose, Raising the blood glucose level

I) Testes:

Released: Androgens (testosterone)Function: responsible for the growth and developmentof the male reproductive structures, muscle enlargement, growth of body hair, voice changes, and the male sexualdrive. J) Ovaries: Released: Estrogens and progesteroneFunction: development and function of female reproductive structuresand other female sexual characteristics. These characteristicsinclude enlargement of the breasts and distribution of fat, which influences the shape of the hips, breasts, and legs. Thefemale menstrual cycle is controlled by the cyclical release ofestrogen and progesterone from the ovaries.

Task 2

List all hormones produced by the adrenal cortex and medulla (see figure B)The adrenal medulla secretes two major hormones: epinephrine(adrenaline), 80%, and norepinephrine (noradrenaline) 20%. As well as a trace of dopamine. The adrenal cortex secretes three hormone types: mineralocorticoids which include aldosteroneAnd glucocorticoids

which include cortisol and cortisoneThe adrenal cortex also secretes androgens (sex hormones like testosterone or androsterone).(Criterion 1. 2)Figure Badrenal-cortexadrenal-medulla2a. Explain the physiological effects of the catecholaminesCatecholamines such as epinephrine and nophrephenine Adrenaline binds to receptors on the heart, arteries, pancreas, liver, muscles and fatty tissue. The main overall effect is to increase alertness and stamina during situations of fear stress of dange. epinephrine and nophrephenine have different physiological functions as shown in the table below

Function Affected

Epinephrine

Norepinephrine

heartRate increasesForce of contraction increasesRate increasesForce of contraction increasesBlood vesselsVessels in skeletal muscle widendecreasing resistance to blood flow vesselsBlood flow to skeletal muscles increasesresulting from constriction of blood, in skin and visceraSystemic blood pressureSome increaseGreat increase due to vasoconstriction, output counteracted in muscle blood vessels duringairwaysDilatedSome dilationReticular formation of brainActivatedLittle effectliverPromotes breakdown of glycogen to glucose, increasing blood sugar levelLittle effect on blood sugarMetabolic rateincreasesincreases2b. Explain the physiological effects of the mineralcorticoids and the glucocorticoids

Physiologic Effects of Mineralocorticoids

Mineralocorticoids help regulate sodium and potassium in the body. A lack of these hormones can be life threatening, due to abnormalities in electrolyte and fluid balance. Aldosterone is the most important mineralocorticoid, The major target of Mineralocorticoids and in particular aldosterone is the kidney, where it stimulates the exchange of sodium and potassium, it does this in three ways1) Increases absorption of sodium and therefore less sodium is lost in urine2) Increases absorption of water, which in turn aids sodium absorption as there is more fluid inside the body causing an osmotic effect. 3) Increases excretion of potassium via the kidneyAldosterone also has effects on sweat glands, salivary glands and the colon which all aid with the retention of sodium

Physiologic Effects of Glucocorticoids

CortisolCortisol (hydrocortisone) is a glucocorticoid, whichmeans it affects glucose metabolism. In addition to affecting glucose, cortisol influencesprotein and fat metabolism. cortisol inhibits the synthesis of protein in various tissues, and increases blood concentration of amino acids. It promotes the release of fatty acids from adiposetissue, increasing the use of fatty acids as an energysource and decreasing the use of glucose as anenergy source. It stimulates liver cells to synthesize glucose fromnoncarbohydrates (gluconeogenesis), such ascirculating amino acids and glycerol, thusincreasing blood glucose concentration. Cortisol’s actions help keep the blood glucose concentrationwithin the normal range between meals. Theseactions are important because just a few hours withoutfood can

exhaust liver glycogen, another major source ofglucose. Cortisol also relieves pain by• decreasing permeability of capillaries, preventingleakage of fluids that swell surrounding tissues• stabilizing lysosomal membranes, preventingrelease of their enzymes, which destroy tissue• inhibiting prostaglandin synthesis(Criteria 1. 2, 2. 1 and 2. 2, Max 150 each)Explain how and when adrenaline is secreted by the adrenal glands(Criteria 2. 2 and 3. 4 Max 150)When the brain perceives an environement as threatening, streesful or exciting, the hypothalamus signals to the adrenal glands to produce andrenaline. Andrenaline is produced in the adrenal medulla which are located on top of the kidney. The adrenal medulla converts tyrosine into dopamine. When dopamine receives oxygen it turns into norandrenaline this is then converted to andrenaline. Adrenaline binds to receptors on the heart, arteries, pancreas, liver, muscles and fatty tissue. This in turn Increases the heart rate, widens the blood vessels (increasing blood flow), widens the of bronchi and a breaks down glycogen to glucose, this in turn raises the blood sugar level providing energy/fuel in a flight or fight situation. Metabolic rate also increases

Task 3

1. Explain what happens if blood calcium levels rise above 11mg/100ml99% of calcium ions (Ca2_) in the body is contained in the bones and teeth. The remaining 1% (around 1. 5 gramms) is contained in the blood. The blood calcium levels are regulated by hormones and kept within the range of 9mg/100ml to 11mg/100ml. if the blood calcium levels rise above 11mg/100ml in the blood its termed hypercalcemia. Hypocalcemia increases

the permeability of plasma membranes to Na. As a result, nerve and muscle tissues undergo spontaneous action. Hypercalcemia prevents normal depolarizationof nerve and muscle cells. High levels of Ca2 levels cause thedeposits of calcium carbonate salts in soft tissues to build up, causing irritation and inflammation. When the calcium levels rise, the thyroid gland releases Calcitonin, this reduces Ca2 levels. Bones can also play a role in reducing blood calcium levels, by inhibiting calcium from bone into the blood. Explain what happens if blood calcium levels drop below 9mg/100mlWhen the blood calcium levels drop below 9mg/100ml it is termed Hypocalcemia . Hypocalcemia means an increase in the permeability of plasma membranes to Na. As a result, nerve and muscle tissues undergo spontaneous action. As a result the para- thyroid gland secretes parathyroid hormone (PTH) resulting in increased numbers of osteoclasts, which causes increased bone breakdown allowing more calcium to enter the blood, raising calcium levels. PTH also regulates blood calcium levels by increasing calciumuptake in the small intestine Increased PTHpromotes the formation of vitamin D in the kidneys, and vitaminD increases the absorption of calcium from the small intestine. PTH also increases the reabsorption of calcium from urine in thekidneys, which reduces calcium lost in the urine. Explain the positive feedback mechanism by which oxytocin promotes labour contracts during birth. Stretching of the uterine and vaginal tissues towards the end of a pregnancy during labourinitiates nerve impulses to the hypothalamus. The hypothalamus signals the posterior pituitary gland to release the hormone oxytocin. Oxytocin promotes uterine contractions. As the fetus is pushed more against the cervix, more oxytocin is released in a continuous positive

feedback cycle Combined with the greaterexcitability of the myometrium due to the decline inprogesterone secretion, oxytocin aids labor in its laterstages. Oxytocin promotes uterine contractions in two ways. Oxytocin stimulates the release of prostaglandin E2 and prostaglandin F2a in fetal membranes by activation of phospholipase C. The prostaglandins stimulate uterine contractility. Oxytocin can also directly induce myometrial contractions through phospholipase C, which in turn activates calcium channels and the release of calcium from intracellular stores.(Criterion 3. 3, Max 150 each)

Task 4

1. List all hormones produced by the anterior and posterior pituitary(Criterion 1. 2)The Anterior Pituitary (Adenohypophysis)Produces the following hormones, Prolactin, Follicle-stimulating hormone (FSH), Luteinizing hormone (LH), Melanocyte hormone (MSH), Beta Endorphins, LipotropinsAdrenocorticotropic hormone (ACTH), Thyroid-stimulating hormone (TSH) and Growth hormone (GH). The Posterior Pituitary (Neurohypophysis), produces, Antidiuretic hormone(ADH) and oxytocin

Posterior Pituitary (Neurohypophysis)

ADH ADH promotes the retention of waterby the kidneys so that less water is excreted in the urineand more water is retained in the blood. oxytocin stimulates contractions ofthe uterus during labor. Oxytocin also stimulates contractions of the mammary gland alveoli and ducts, whichresult in the milk-ejection reflex in a lactating woman. Inmen, a rise in oxytocin secretion

at the time of ejaculationhas been measured, but the physiological significance ofthis hormone in males remains to be demonstrated.

Anterior Pituitary (Adenohypophysis)

GH acts on the liver, stimulating it to produce another hormone called growth factors. It is this second hormone, which directly affects the growth of bone and muscle. GH also increases glycogen synthesis, blood glucose levels and somatomedin productionTSH simulates thyroid hormone secretionACTH ACTH binds to membrane-bound receptors on cells of the adrenal cortexand stimulates the secretion of glucocorticoidsLipotropins increase fat breakdownBeta Endorphins help with pain relief in the brain and also inhibition of gonadotropinreleasing hormone secretionMSH function is to increase melanin production in melanocytes to makethe skin darker in colorLH simulates Ovulation and progesterone production in ovaries; testosterone synthesis and support for sperm cell production in testesFSH simulates Follicle maturation and estrogen secretion in ovaries as well as sperm cell production in testesProlactin simulates Milk production in lactating women however it has an unclear physiological effect in males2a. Explain the physiological effects of the anterior pituitary hormones2b. Explain the physiological effects of the posterior pituitary hormones(Criteria 1. 2, 2. 1 and 2. 2, Max 150 each)3a. Describe how and when ADH is secreted by the posterior pituitaryAntidiuretic hormone (ADH), is secreted by the posterior pituitary gland. The release of ADH from the posterior pituitary is regulatedby the hypothalamus. Certain cells of the hypothalamusare sensitive to changes in the solute concentration of thefluid within the

hypothalamus. An increased soluteconcentration of the blood and fluid results in messenger hormones being sent along the axons of the ADH secretingneurons of the hypothalamus to the posterior pituitary, causing ADH to be released from the ends of the axonsA reduced solute concentration in the bloodand interstitial fluid within the hypothalamus causes inhibitionof ADH release. Baroreceptors that monitor blood pressure also influenceADH secretion. Increased blood pressure causes a decreasein ADH secretion, and decreased blood pressure increasesADH secretion3b. Describe how and when ACTH is secreted by the anterior pituitary(Criterion 3. 1 and 3. 4, Max 150 each)When the brain receives signals of stress, the hypothalamus releases . Corticotrophin which travels down the hypothalamohypophysial portal system, to the anterior pituitary gland. In the anterior pituitary CRH binds to and stimulates cells that secreteadrenocorticotropic hormone (ACTH). During this process several other hormones are also created such as lipoproteins, Beta-endorphins, Met-enkephalins and Melanocyte-stimulating hormone (MSH)ACTH is then released into the blood stream and attaches to the adrenal gland, simulating the adrenal cortex to secrete glucocorticoids such as cortisol. It doesn’t control aldosterone (the other hormone secreted by the adrenal cortex)Cortisol inhibits CRH and ACTH secretion. And is thus called a negative feedback loop (http://www. vivo. colostate. edu/hbooks/pathphys/endocrine/hypopit/acth. html, 2012)Explain the functional relationship between the hypothalamus and the pituitary gland (see Figure C)Hypothalamic Control of the Posterior PituitaryBoth of the posterior pituitary hormones—ADHand oxytocin, are actually produced in

neuron cell bodies of thesupraoptic nuclei and paraventricular nuclei of the hypothalamus. These nuclei within the hypothalamus are thus endocrineglands. The hormones they produce are transported along axonsof the hypothalamo-hypophyseal tract to the posteriorpituitary, where they are stored and later released. The posteriorpituitary is thus more a storage organ than a producing gland. The release of ADH and oxytocin from the posterior pituitaryis controlled by neuroendocrine reflexes. In nursingmothers, for example, the mechanical stimulus of suckling acts, via sensory nerve impulses to the hypothalamus, to stimulate thereflex secretion of oxytocin. The secretion of ADHis stimulated by osmoreceptor neurons in the hypothalamus inresponse to a rise in blood osmotic pressure; its secretionis inhibited by sensory impulses from stretch receptorsin the left atrium of the heart in response to a rise in blood volumeHypothalamic Control of the Anterior PituitaryThe anterior pituitary is not really the master gland, since secretionof its hormones is in turn controlled by hormones secretedby the hypothalamus. Releasing and Inhibiting HormonesSince axons do not enter the anterior pituitary, the hypothalamusControls the anterior pituitary with hormonesAs appose to neural regulation. Hormones, produced by the hypothalamus, are transportedto the axon endings in the basal portion of the hypothalamus. This area has extremerly small blood vesselsThe blood vessels that drain the hypothalamus deliver bloodto a second set of blod vessels in the anterior pituitary. Since these blood vessles below the blood vessels in the hypothalamus, the recieve and receives deoxygenated blood from it, the vascularlink between the outer part of the hypothalamus and the anterior pituitaryforms a portal system. The vascular link between the

hypothalamusand the anterior pituitary is thus called the hypothalamohypophysealportal system. Regulatory hormones are secreted into the hypothalamohypophysealportal system by neurons of the hypothalamus. Thesehormones regulate the anterior pituitary. Thyrotropin releasing hormone (TRH)stimulates the secretion of TSH. corticotropin-releasing hormone(CRH) stimulates the secretion of ACTH from the anteriorpituitary. A single releasing hormone, gonadotropin-releasinghormone, or GnRH, stimulates the secretion of both gonadotropichormones (FSH and LH) from the anterior pituitary. Prolactin and the growth hormone from the (anteriorPituitary) is regulated by hormones, known as prolactin-inhibiting hormone (PIH) and somatostatin. A specific growth hormone-releasing hormone (GHRH)