ENDOCRINE

ANATOMY

8

WRITER:
Noor Abu Hantash

CORRECTOR:
Salam Omoosh

DOCTOR:
Ghada abu-Al Ghanam

PANCREAS

-it has been mentioned in the first lecture, that endocrine glands are either mixed or pure glands.

-pancreas is one of these mixed glands

-it has exocrine activities→specialized in secreting digestive enzymes, so obviously, it will be covered in our next system:)

-its exocrine activity much more than the endocrine.

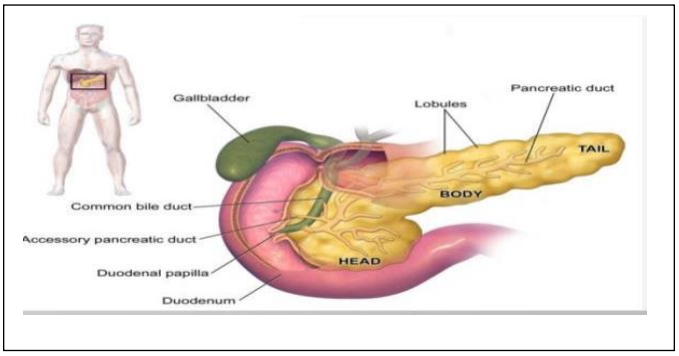
-and it has endocrine activities, our sheet topic*-*

*some general anatomical info about the pancreas:

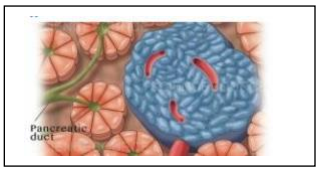
-it locates in the abdomen, anterior to the diaphragm, and behind the stomach.

-it has a head(wrapped by the duodenum), a body, and a tail.

THE PANCREATIC ISLETS (ISLETS OF LANGERHANS)



• Are compact spherical or ovoid masses of endocrine cells embedded within the acinar exocrine tissue of the pancreas.



• Most islets are 100-200 µm in diameter and contain several hundred cells, but some have only a few cells.

• The pancreas has more than 1 million islets (mostly in the tail region)

-But they only constitute 1%-2% of the organ's total volume.

-A thin reticular capsule surrounds each islet, separating it from the adjacent acinar tissue, these coats are important for aligning the islets to be supplied with blood vessels in clusters

-Pancreatic islets have the same embryonic origin as the pancreatic acinar tissue: in epithelial outgrowths from the endoderm of the developing gut.

• The cells of islets are polygonal or rounded, smaller, and more lightly stained than the surrounding acinar cells

the cells of endo are aligned in coats around capillaries to deliver their contents

• Arranged in cords separated by fenestrated capillaries.

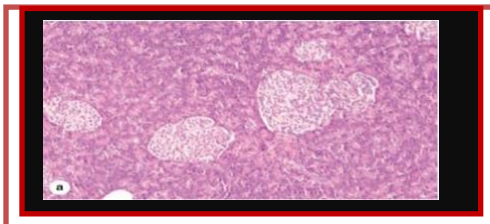
• Most islet cells are acidophilic or basophilic with fine cytoplasmic granules.

• Active polypeptide-secreting cells, with secretory granules that vary in size, morphology, and electron density from cell to cell.

HISTOLOGY OF PANCREATIC ISLETS

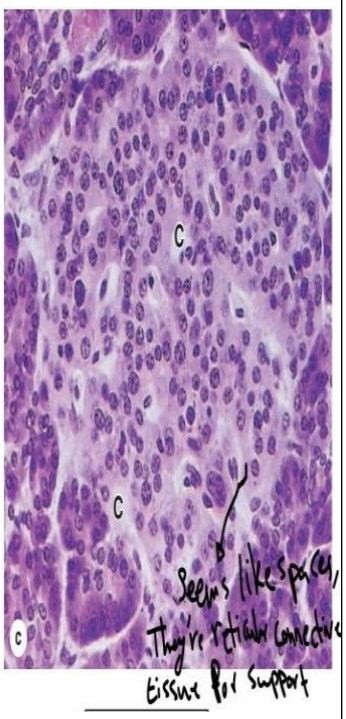
-Pancreatic islets are clumped masses of pale-staining endocrine cells embedded in the exocrine acinar tissue of the pancreas.

-notice from the fig that we have 2 different patterns of stains, so there are 2 tissues(endo: smaller vesicles, less content and lightly stained,,, and exo: larger vesicles with more contents and darkly stained)



The islets are scattered clusters of cells with smaller and lighter staining than cells of the surrounding tissue.

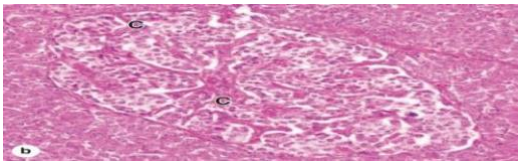
-H&E



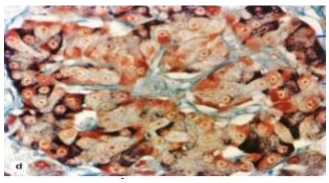
With H&E staining all cells of an islet appear similar, although differences in cell

size and basophilia may be apparent. Capillaries (C) are also apparent.

-notice that there are areas seem like spaces but actually they are reticular connective tissues for support



At higher magnification, an islet's capillary system can be seen. Several arterioles enter each islet, branch into fenestrated capillaries (C)among the peripheral islet cells, then converge centrally before leaving the islet as efferent capillaries carrying blood to the acini surrounding the islet. This local vascular system allows specific islet hormones to help control the secretion of other islet cells and the neighboring acini.

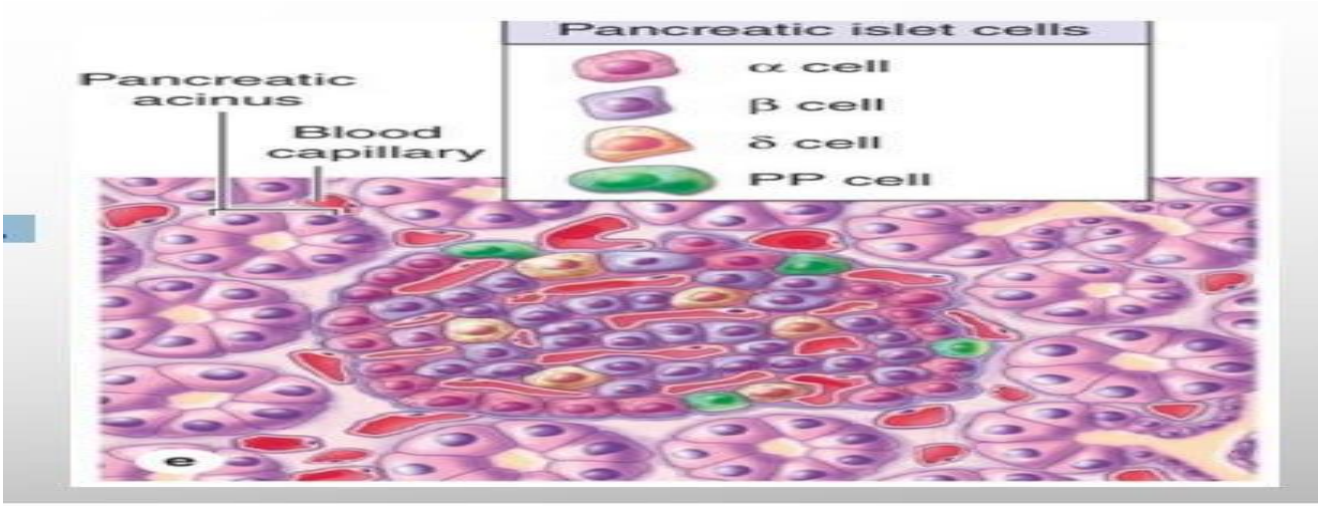


-special stain

-4 subgroups of cells, more distributed in the tail

- An islet prepared with a modified aldehyde fuchsin stain shows that granules in the peripheral α cells are a deep brownish purple and the central β cells granules are brownish oranges. Reticulin connective tissue of the islet capsule and along the capillaries stains green in this preparation. Immunohistochemistry with antibodies against the various islet polypeptide hormones allows definitive identification of each islet cell type

CELLS



• The Major islet cells are most easily identified and studied by immunohistochemistry:

1. a or A cells secrete primarily glucagon and located peripherally.

-glucagon is the starvation hormone

-it activates glycogenolysis, gluconeogenesis, ….

-remember: the sources of body energy ordinarily are: carbs, fats, and proteins

2. b or B cells produce insulin (l. Insula, island),

most numerous, and located centrally.

-when you listen ‘’insulin’’, you will think definitely about diabetes

-let’s discuss some painful information about this disease

- 40% of the Jordanian population is diabetic(PANDEMIC!)

-Diabetes mellitus is characterized by loss of the insulin effect and a subsequent failure of cells to take up glucose, leading to elevated blood sugar or hyperglycemia. Type 1 diabetes or insulin-dependent diabetes mellitus (IDDM) considered an autoimmune disease, is caused by the loss of the β cells from autoimmune destruction and is treated by regular injections of insulin. It has multiple causes(multifactorial) and they could be genetic or viral since viruses can interfere with the genetic material and a lot of other unknown factors, it is recorded more in earlier ages.

- In type 2 diabetes or non–insulin-dependent diabetes mellitus (NIDDM), β cells are present but fail to produce adequate levels of insulin in response to hyperglycemia and the peripheral target cells “resist” or no longer respond to the hormone. Type 2 diabetes commonly occurs with obesity(no.1), and changes in the biological clock and poorly understood, multifactorial genetic components are also important in this disease’s onset. More recordings among adults.

3. d or D cells, secreting somatostatin, are scattered and much less abundant.

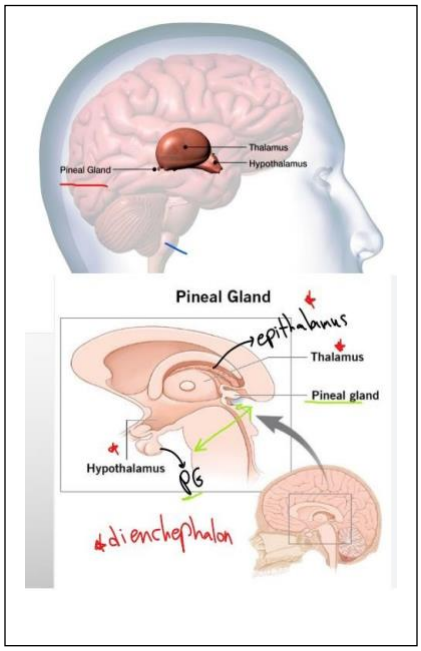
4. PP cells secrete a pancreatic polypeptide, more common in islets located within the head

skip this column

Cell Type	Quantity (%)	Hormone Produced	Hormone Structure and Size	Hormone Function
α	~20	Glucagon	Polypeptide; 3500 Da	Acts on several tissues to make energy stored in glycogen and fat available through glycogenolysis and lipolysis; increases blood glucose content
β	~70 most abundant!	Insulin	Dimer of α and β chains with S-S bridges; 5700-6000 Da	Acts on several tissues to cause entry of glucose into cells and promotes decrease of blood glucose content
δ or D	5-10	Somatostatin	Polypeptide; 1650 Da	Inhibits release of other islet cell hormones through local paracrine action; inhibits release of GH and TSH in anterior pituitary and HCl secretion by gastric parietal cells
PP	Rare	Pancreatic polypeptide	Polypeptide; 4200 Da	Stimulates activity of gastric chief cells; inhibits bile secretion, pancreatic enzyme and bicarbonate secretion, and intestinal motility

-take a breath

PINEAL GLAND الغدة الصنوبرية

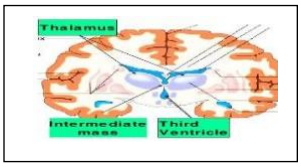


-it is a pure endocrine gland

-locates between the 2 cerebral hemispheres, between the 2 thalamic bodies, in the the opposite pole of the pituitary gland

-the thalamus is separated into 2 big masses, so the pineal locates in between.

-the pineal gland originates from the neural crest of the ectoderm, so it is nervous tissue in origin, but endocrine in function.



-A small, pine cone-shaped organ (5-8 mm by 3-5 mm) and weighs 0.1g

- **Also known as the epiphysis cerebri**
- **Resides between the thalamic bodies.**
- **Has a rich blood supply**
- **Innervated by postganglionic sympathetic nerve fibers.**
- **Covered by connective tissue(CT) of the pia mater (septa).**

-it is also divided inside by CT septa

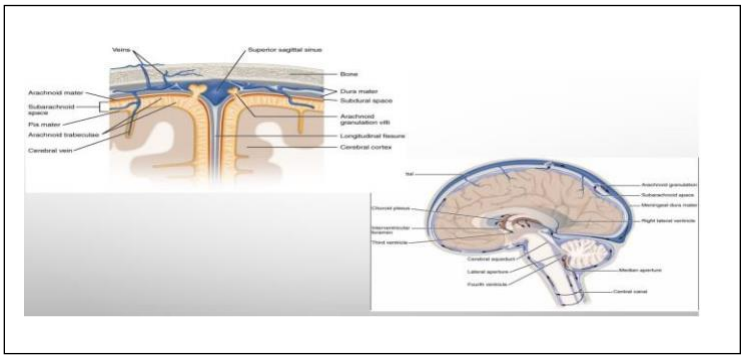
- **Posteriorly from the posterior end of the roof of the third ventricle of the brain:**

-let me tell you a little bit long story to understand this point:)

-CSF:

1)fills the subarachnoid space

2)Surrounds the brain and the spinal cord

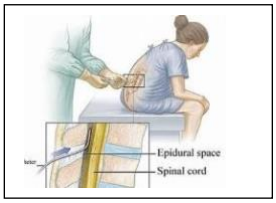


3) is produced by specialized ependymal cells in the choroid plexus of the ventricles of the brain

4)it is important for reflexing the internal environment of the brain

5)A sample can be collected from the spinal cord

6)Epidural anesthesia: is a medicine used to numb you so you do not feel pain during surgery, distributed in the CSF



-coming back to our topic:

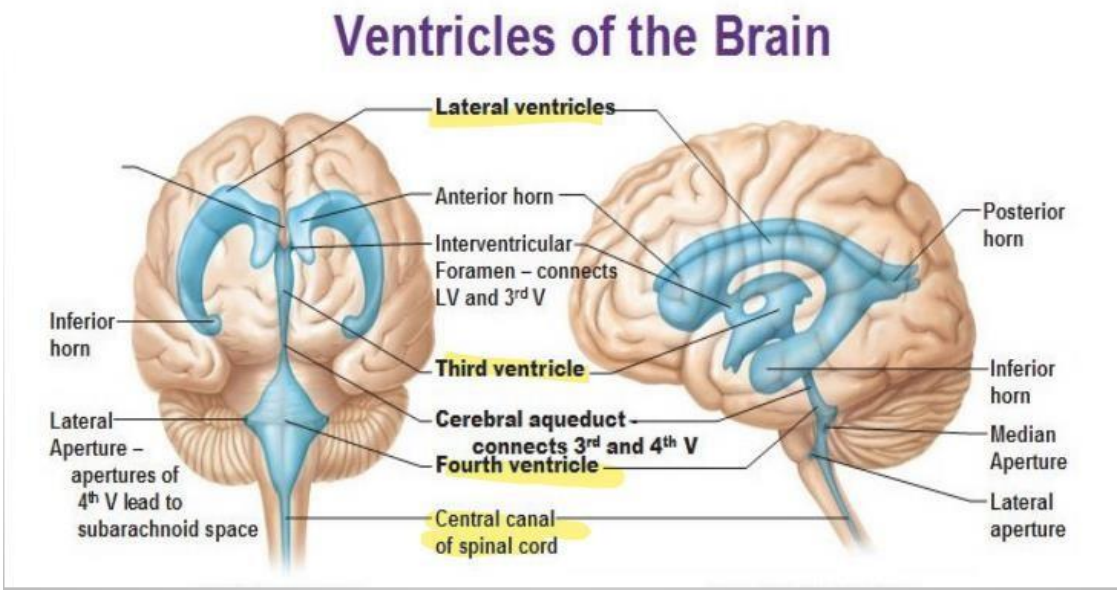
According to point 3, the brain has spaces called ventricles where CSF is produced by ependymal cells,

There are 3 ventricles:

-the lateral ventricle: the biggest one, it connects with all cerebral lobes and then it continues to

-the third ventricle: OUR INTEREST, the pineal gland originates from its posterior end forming its roof

-the central canal of the spinal cord



HISTOLOGY

- **Prominent and abundant secretory cells-pinealocytes.**
- **Slightly basophilic cytoplasm and irregular euchromatic nuclei**

-euchromatin: active cell, lightly packed genetic material

- **Secretory vesicles, many mitochondria, and long cytoplasmic processes.**

-long cytoplasmic process: indicates that it is a modified nervous tissue

- **Produce melatonin: a low-molecular-weight, a tryptophan derivative.**
- **Unmyelinated sympathetic nerve fibers enter the pineal gland and end among pinealocytes (some form synapses)**

MELATONIN

-Melatonin release is promoted by darkness and inhibited by daylight
Diurnal fluctuation in blood melatonin levels---rhythmic changes in the activity of the hypothalamus, PG, and other endocrine tissues.

-no light→melatonin is secreted

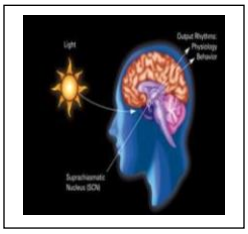
-Some small studies have suggested that melatonin is helpful for jet lag if taken a few days before and after travel. Melatonin is a natural substance released by our brain to help with our circadian (day/night) rhythm. This rhythm is disturbed with travel across three or more time zones.

-so, how does the pineal know that it is the time for melatonin secretion??

Simply-not simply at all-by the retinohypothalamic tract.

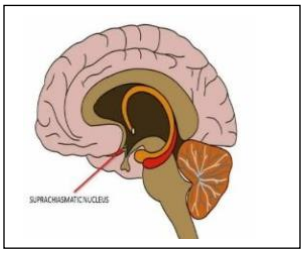
The cycle of light and darkness is detected within the retinas and transmitted to the pineal via the retinohypothalamic tract, the suprachiasmatic nucleus, and the tracts of sympathetic fibers entering the pineal G.

-by the ganglionic cells in the retina, which only function in sensing the light, and they are incapable to send images,



They form around 1-2% of the retina, called the intrinsically photosensitive retinal ganglion cells (ipRGC), which contains the photopigment melanopsin.

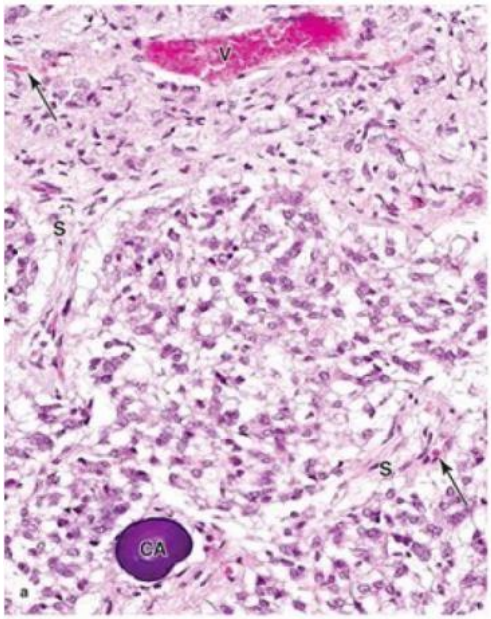
The axons of the ipRGCs belonging to the retinohypothalamic tract project directly**, monosynaptically**, to the suprachiasmatic nuclei (SCN) via the optic nerve and the optic chiasm. The suprachiasmatic nuclei receive and interpret information on environmental light, dark and day length,

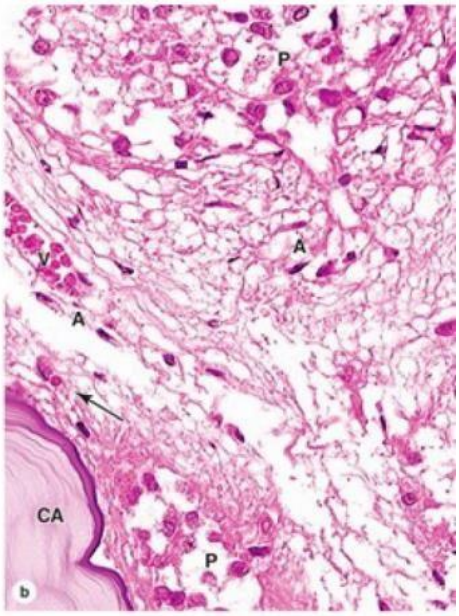


important in the entrainment of the "body clock". They can coordinate peripheral "clocks" and direct the pineal gland to secrete the hormone melatonin. Increasing melatonin in the blood gives the feeling of tiredness and sleeping.

-melatonin isn't just responsible for the biological clock, but it also interconnects with other hormones in the body like inhibiting ACTH, which is responsible for awakeness, that's why the people who are staying up late are the most predisposed for diabetes and hypertension.

- The pineal gland---a neuroendocrine transducer(facilitator), converting sensory input into variations in many hormonal functions





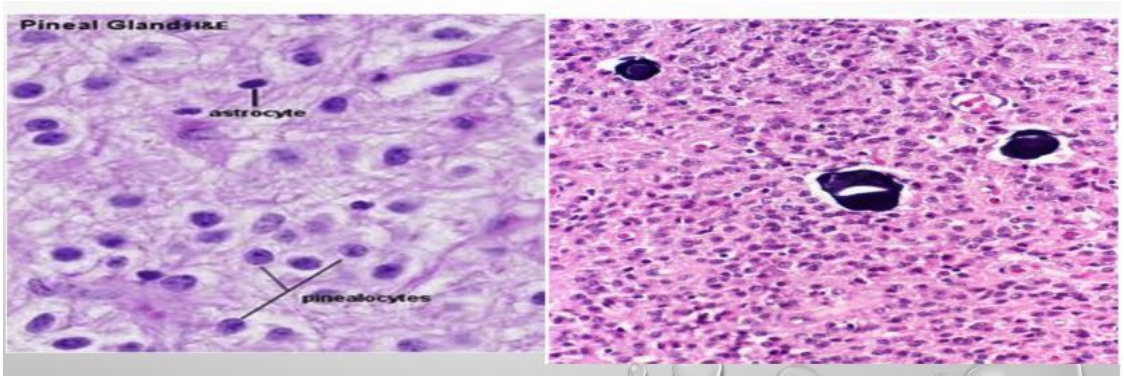
Note:

Pinealocytes appear lighter in staining bcz they are euchromatin, and the DNA is diffuse

(a) The micrograph shows a group of pinealocytes surrounded by septa (**S**) containing venules (**V**) and capillaries (arrows). Also seen is an extracellular mineral deposit called a **corpus arenaceum** (**CA**) of unknown physiologic significance but an excellent marker for the pineal. (X200; H&E)

(b) At higher magnification the numerous large pinealocytes (**P**) with euchromatic nuclei can be compared to much fewer astrocytes (**A**) that have darker, more elongated nuclei and are located mainly within septa and near small blood vessels (**V**). Capillaries (arrow) are not nearly as numerous as in other endocrine glands. At the lower left is a part of a very large corpus arenaceum (**CA**), the calcified structures also known as **brain sand**. Along the septa run unmyelinated tracts of sympathetic fibers, associated indirectly with photoreceptive neurons in the retinas and running to the pinealocytes to stimulate melatonin release in periods of darkness. Levels of circulating melatonin are one factor determining the diurnal rhythms of hormone release and physiologic activities throughout the body. (X400; H&E)

-Extracellular mineral deposit: corpus arenaceum (C A) (a marker for the pineal).



Has interstitial glial cells (modified astrocytes) which represent 5% of the cells--- elongated nuclei more heavily stained than those of pinealocytes and found in perivascular areas. Astrocyte appears smaller and darker while pinealocyte is active so it is stained lighter.

• Corpora arenacea, or brain sand (concretions of calcium and magnesium salts), formed by mineralization of extracellular protein deposits.

• May appear during childhood and gradually increase in number and size with age, with No apparent effect on the gland's function. For example if there are two histographs one with more CA and the second with less CA in number, the higher CA would be for an older person

ORGANOGENESIS

- **7th-8th week.**
- **Develops from neuroectoderm (posterior wall of the third ventricle).**
- **Neuroepithelium that lines the roof of the third ventricle in the prenatal brain, and its maturation continues postnatally.**
- **The development of the mature gland is seen in the first decade of life. Basically, the pineal gland will increase in size from birth to about 2 years in age**

PINEAL GLAND FUNCTIONS

- **Influences the activities of the pituitary gland, the Islets of Langerhans of the pancreas, the parathyroids, the adrenals, and the gonads.**
- **The pineal secretions, reach their target organs via bloodstream or cerebrospinal fluid.**
- **Their actions are mainly inhibitory.**
- **Directly inhibit the production of hormones or indirectly inhibit the secretion of releasing factors by the hypothalamus**

QUESTIONS

1.Secretion in what neuroendocrine cell is controlled directly by neural activity and involves a hormone that generally slows metabolic activity at night?

a. Pituicyte

b. Melanocyte

c. Herring body of the neurohypophysis

d. Chroma(n cell

e. Pinealocyte

2.A glucagonoma is a malignant tumor consisting of what cells?

a. A or α cells

b. B or β cells

c. Chromophils

d. D or δ cells

e. Mucous cells

3. A 9-year-old girl, the youngest of four daughters, is taken to the pediatrician by her mother, who indicates that for at least 4 months the child has seemed "hyperactive," unable to sleep soundly because "she says her room is too hot," and no longer able to concentrate in school. Upon questioning, the mother also remembers that her daughter's periods also began within the past few months. Blood tests indicate high levels of estrogen-related hormones and cortisol. Which of the following tentative diagnoses is consistent with all of these symptoms?

a. Graves disease, caused by antibodies stimulating the TSH receptor

b. A defect in the PVN

c. Excessively active cells of the adrenal cortex zona glomerulosa

d. A benign tumor involving cells in the adenohypophysis

e. A disabling mutation in the gene for thyroglobulin

4.Some mammalian endocrine tissues or cells can be experimentally transplanted to other well-vascularized sites (such as the oral mucosa) in genetically similar hosts and the tissue's function continues normally and with proper regulation. the pars distalis is not a good candidate for such transplantation studies for which one of the following reasons?

a. More severe rejection of neurally related tissue occurs compared with other endocrine organs.

b. Its hormonal source is unavailable after its axonal connections to the hypothalamus are disrupted.

c. Its cells stop functioning when separated from the hypothalamo-hypophyseal portal system.

d. Neogenesis of blood vessels into this tissue will not occur at the transplant site.

e. the vascular wall of the superior hypophyseal arteries is

unique

e a d c

V2

The added sentences are highlighted with yellow.