

Chemical Coordination and Integration

Case Study Based Questions

Read the following passages and answer the questions that follow:

1. A 20-year-old female patient was admitted in October with a 3-month history of persistent vomiting between 5 and 15 times a day and weight loss. She was dehydrated and unable to tolerate oral intake due to nausea and vomiting. Her bowel motions were normal; she had no problems with micturition or symptoms of infection, however had noticed significant weight loss in the preceding few months. She was diagnosed with Addison's disease. This disease is known to have associations with other conditions; therefore, knowledge of this can lead to prompt diagnosis and earlier management once this diagnosis is made.



(A) Name the gland associated with the disease. Hormones are secreted by which part of this gland? Name the hormones associated with above events.

(B) They are also known as hormone. Give a reason.

(C) What is the physiological function of these hormones?

Ans. (A) Adrenal gland is made of inner adrenal medulla and outer adrenal cortex. Adrenal medulla secretes hormones known as catecholamines, i.e. adrenaline and noradrenaline. Adrenal medulla is centrally located tissue of the adrenal gland. It secretes two types of hormones commonly called catecholamines:

(1) Adrenaline: Also known as epinephrine.

(2) Noradrenaline: Also known as norepinephrine.

(B) They are also known as emergency hormones secreted in an emergency situation in our body. It is secreted in response to any stress, during emergencies, thus also known as emergency hormones or hormones of fight, fright and flight (3F hormone).

(C) These hormones function by increasing alertness, pupillary dilation, piloerection and sweating. It results in an increased heartbeat and rate of respiration. They also stimulate

catabolism of glycogen that causes increased blood glucose level. It also stimulates catabolism of protein and lipids.

2. Type 2 diabetes mellitus is likely the third modifiable risk factor for pancreatic cancer after cigarette smoking and obesity. Epidemiological investigations have found that long-term type 2 diabetes mellitus is associated with a 1.5-fold to 2.0-fold increase in the risk of pancreatic cancer. A causal relationship between diabetes and pancreatic cancer is also supported by findings from pre diagnostic evaluations of glucose and insulin levels in prospective studies. Insulin resistance and associated hyperglycemia, hyperinsulinemia, and inflammation have been suggested to be the underlying mechanisms contributing to development of diabetes- associated pancreatic cancer. Signalling pathways that regulate the metabolic process also play important roles in cell proliferation and tumour growth.



(A) Name the gland associated with the first type of disease mentioned in the case and write its composition.

(B) Name the hormone secreted by the B-cells of this gland.

(C) Name the disease associated with glucagon.

Ans. (A) Pancreas is a composite gland; acts as both an exocrine and endocrine gland. It consists of 'Islets of Langerhans' made up of two main types of cells that are, α -cells and β -cells that secrete glucagon and insulin, respectively.

(B) β -cells secrete a peptide hormone, i.e. insulin that regulates glucose homeostasis, it mainly acts on hepatocytes and adipocytes, i.e. cells of fat tissue, improving cellular glucose uptake and utilisation that causes rapid movement of glucose from blood to hepatocytes and adipocytes resulting into hypoglycemia, i.e. decreased blood glucose levels. It stimulates glycogenesis in targeted cells.

(C) It mainly acts on liver cells, i.e. hepatocytes and stimulates glycogenolysis and gluconeogenesis causing hyperglycemia, i.e. increased blood sugar. It reduces cellular glucose uptake and utilisation. Thus, it is a hyperglycemic hormone.

3. Xenoestrogens are found in a variety of everyday items. Its sources are plastic, pesticides, insecticides, beauty products, etc. Many of us don't think twice about the make-up we wear or the container we use to pack a lunch. Unfortunately, this may be altering the way our body works naturally because they all contain endocrine disruptors called Xenoestrogens. Xenoestrogens are a subcategory of endocrine disruptor that specifically has estrogen-like effects. Estrogen is a natural hormone synthesised by the growing ovarian follicles in females. It helps in the growth of female secondary sex organs and female secondary sex characters. It is also important for bone growth and reproduction in men and women. When xenoestrogen enters the body they increase the total amount of estrogen in the body resulting in a phenomenon called estrogen dominance. As they are not biodegradable they are stored in our fat cells. This leads to breast cancer, prostate cancer, obesity, infertility, miscarriages and diabetes.

(A) Xenoestrogen mimics the action of..... and its excess cause.....

- (a) Progesterone, bone and prostate cancer
- (b) Estrogen, breast and prostate cancer
- (c) Cortisol, brain and blood cancer
- (d) Thyrocalcitonin, bone and lung cancer

(B) Estrogen is secreted mainly by:

- (a) GI tract
- (b) Pancreas
- (c) Growing ovarian follicles
- (d) Thymus

(C) Select the function/functions performed by estrogen in females:

- (a) Growth of female secondary sex organs
- (b) Bone growth
- (c) Female secondary sex-characters
- (d) All of the above

(D) What measures, as an individual you would take to reduce your exposure to these harmful xenoestrogens?

- (a) Eat local and organic food.
- (b) Use beauty products made from natural ingredients.
- (c) Do not use plastic lunch boxes and water bottles.
- (d) All of the above

(E) Assertion (A): Estrogen belongs to the class of steroid hormones.

Reason (R): Cholesterol is the precursor used in synthesising estrogen hormone.

- (a) Both A and R are true and R is the correct explanation of A.
- (b) Both A and R are true and R is not the correct explanation of A.
- (c) A is true but R is false.
- (d) A is false but R is true.

Ans. (A) (b) Estrogen, breast and prostate cancer

Explanation: Xenoestrogens are clinically significant because they can mimic the effects of endogenous estrogen and thus have been implicated in precocious puberty and other disorders of the reproductive system.

(B) (c) Growing ovarian follicles

Explanation: The female sex hormone is oestrogen. Under the influence of FSH, it is mostly released by the granulosa cells of the ovarian follicles (in the ovary). Additionally, the placenta and the corpus luteum (after the egg has been expelled from the follicle) release these hormones.

(C) (d) All of the above

Explanation: In addition to breast enlargement and nipple erection, secondary sexual characteristics that emerge during puberty include pubic and underarm hair growth, wider hips, a lower waist-to-hip ratio than adult males, smaller hands and feet than men, a rounder face, and greater development of thigh muscles behind the femur rather than in front of it.

(D) (d) All of the above

Explanation: Common sources of xenoestrogens are food, plastic, skin care products, building supplies, pesticides, and contraceptives. Here are a few ways to reduce your exposure the xenoestrogens:

- (1) Avoid pesticides by choosing organic, locally grown, and in season foods.
- (2) Peel non-organic fruits and vegetables.
- (3) Buy hormone free meats and dairy products.
- (4) Avoid plastics in everyday kitchen products
- (5) Plastic wrap to cover food and by removing plastic covered food as soon as you get home from the store

(E) (a) Both A and R are true and R is the correct explanation of A.