NAME: ONOTHOJA DOMERO

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ASSIGNMENT

1. Discuss the role of kidney in glucose homeostasis?

Kidney plays an important role in glucose homeostasis including during prolonged fasting. The kidney has a vital role in absorbing filtered glucose having a glomerular filtration rate of about 180 litres per day hence, its contribution in maintaining normal fasting plasma glucose levels is very high.

The regulation of endogenous production of glucose is determined by hormonal and neural factors. Insulin from the kidney’s cortex is able to suppress glucose release in both the kidney and liver by direct enzyme activation/deactivation and by reducing the availability of gluconeogenic substrates when the glucose release is higher than the body’s needs

The kidneys are involved in maintaining glucose homeostasis through: gluconeogenesis and renal uptake of glucose

**Gluconeogenesis:** cells in the renal medulla can only use glucose for their needs like the brain and they have enzymes capable of glucose phosphorylation and glycolysis therefore they can phosphorylate important amounts of glucose and accumulate glycogen. Cells in the renal cortex have gluconeogenic enzymes and they can produce and release glucose into the circulation.

In prolonged fast, the kidney uses the process of gluconeogenesis and glucose is produced and released in circulation.

**Glucose reabsorption:** the kidneys contribute to glucose homeostasis by filtering and absorbing glucose as much as possible.

1. Discuss the process of micturition?

Micturition is the process of emptying urine from its storage organ, bladder.

Urine is passed out through the excretory system which includes, a pair of kidneys, two ureters, a urinary bladder and a urethra.

The kidneys filter the urine and it is transported to the urinary bladders via the ureter where it is stored till its expulsion.

* The bladders usually accommodate about 200-400ml in adults.

The process of micturition is regulated by the nervous system and the muscles of the bladder (detrusor muscle) and urethra (internal and external sphincters). Within the nervous system, the process is governed by both the somatic and autonomic nervous system which include the sympathetic and parasympathetic nervous system.

* The control of this process is mediated via afferent signals from the stretch and volume receptors in the bladder as well as from the muscles of the pelvic floor, the vagina/penis and the rectum which informs the brain about the extent of filling, initiating several spinal reflexes. These serve to inhibit micturition until filling is complete while activating the voluntary external urethral sphincter at the same time, detrusor activity is inhibited and the internal urethral sphincter is stimulated via sympathetic activity.
* Impulses from the filling of the bladder are carried to the spinal cord via the pelvic and hypogastric nerves.
* The pontine micturition center in the brainstem is activated via afferent signals from the urinary bladder as it is filling. This center sends inhibitory impulses to the spinal reflex arcs to enable bladder voiding.
* Neurons of the pontine micturition complex are released from inhibition and fire maximally once the voluntary signal for voiding is produced. This causes excitation of the sacral neurons which stimulate detrusor contractions and relaxing the external sphincter.
* The flow of urine and the mechanical distension of the urethra together cause detrusor contractions to occur, which encourages complete bladder emptying.

1. Explain the Juxtaglomerular Apparatus?

The juxtaglomerular apparatus is located between the afferent arteriole and the returning distal convoluted tubule of the nephron. It is responsible for regulating the renin-angiotensin aldosterone mechanism. It has 3 components:

1. Juxtaglomerular cells of the afferent arteriole, synthesize and store renin, which is secreted in response to specific stimuli e.g. decreased NaCl delivery. The juxtaglomerular cells are referred to the effector arm of the renin-angiotensin aldosterone axis.
2. The maula densa which is a region of the distal convoluted tubule characterized by tubular epithelial cells which are densely-packed than in other regions of the nephron. The macula densa is referred as the sensory arm of the renin-angiotensin aldosterone axis and it is involved in the mechanism of the tubuloglomerular feedback.
3. Discuss the role of the kidney in the regulation of blood pressure?

If there is a drop-in blood pressure, the sensory nervous system stimulates juxtaglomerular cells to produce renin (enzyme). This renin converts angiotensinogen to angiotensin-I.

In the lungs, an enzyme called Angiotensin-converting enzyme converts Angiotensin I to Angiotensin II.

This Angiotensin II causes blood vessels to constrict causing blood pressure to increase, it also stimulates the release of the hormone aldosterone in the adrenal glands which causes the renal tubules to retain sodium and water which also causes blood pressure to rise and it stimulates the thirst centres in the hypothalamus hence there is increase in water intake and blood pressure is increased.

1. Discuss the role of the kidney in calcium homeostasis?

About 50% of plasma calcium is freely filtered through the renal glomerulus, and 99% of the filtered calcium is actually reabsorbed along the renal tubules. Parathyroid hormone and Vitamin D enhance calcium reabsorption in the thick ascending limb and distal convoluted tubule. Healthy kidneys turn vitamin D into an active hormone calcitrol, which helps increase calcium absorption from the intestines into the blood.

Plasma calcium itself controls renal calcium absorption through altered PTH secretion as well as via calcium sensing receptor in the thick ascending limb. To facilitate calcium ion reabsorption, the lumen has to be positively charged leading to the drive of absorption of positively charged ions like calcium.