**SANI NANA FATIMA**

**18/SCI05/010**

**MEDICAL LABORATORY SCIENCES**

**ANA 204**

1. **Critically examine the renal function of desert dwellers and the anatomical basis of their unique adaptation.**
2. **Write extensively on the clinical importance of the glomerular filtration barrier.**

1. The urinary system, also known as the renal system, produces, stores and eliminates urine, the fluid waste excreted by the kidneys. The kidneys make urine by filtering wastes and extra water from blood. Urine travels from the kidneys through two thin tubes called ureters and fills the bladder.

From the accompanying diagram you would be able to see that the Henle's loop of juxtamedullary (adjacent to medulla of kidney) nephron goes deep down into the medulla. This is why medulla of camel's kidney is thicker than that of other mammals, but it is most well developed in another desert mammal, the kangaroo rats.

The Henle's loops of juxtamedullary nephrons along with counter flowing blood vessels, called vasa recta, help in conservation of water. Blood first flows along ascending limb of Henle, which is impermeable to water. Solutes can leave the filtrate and enter the blood along this stretch. When this blood flows along descending limb, water is reabsorbed from filtrate but not the solutes. Longer the Henle's loop, more amount of solute will be reabsorbed and hence more amount of water could be removed from filtrate.

The mammalian kidney is a compact organ consisting of an outer dark cortex and an inner pale medulla. The kidney tissue is made up of nephrons, which are thin-walled tubules . The nephrons are concentrated in areas known as pyramids. Ducts that collect the urine and transfer it to the ureter are located in the pa Each nephron begins with a cup-shaped structure, the Bowman's capsule. This encloses the glomerulus, a cluster of capillaries. (The Bowman's capsule and the glomerulus together are sometimes referred to as the Malpighian body.) Bowman's capsule opens into the coiled proximal convoluted tubule, which leads to the loop of Henle. There are two types of nephron, distinguished by the length of their loops of Henle.

Small mammals have much higher mass-specific metabolic rates than large mammals. Compared with large mammals, the apical membranes in the kidney tubules of small mammal epithelial cells have more infoldings, increasing surface area for absorption.

Increased metabolism will lead to more waste products and a greater demand on the filtration capacity of the kidneys. Therefore the number of nephrons must increase as body size increases, which in turn increases the relative amount of cortex (the area of the kidney where most of the nephron is located), at the expense of the medulla. The relative thickness of the medulla is related to urine-concentrating ability because the medulla contains the loops of Henle. Hence larger animals, even the camel, cannot produce urine as concentrated as that of smaller mammals, because their kidney medulla is relatively small compared with its cortex. Small mammals such as rodents and bats tend to have relatively thicker medullas than larger mammals, which can be correlated with their production of concentrated urine.

Conservation of water by the kidney is of crucial importance for the kangaroo rat, which does not drink and can obtain water only from catabolism. Other desert rodents obtain water from their diet. The degu (Octodon -degus), found in Northern Chile, lives in semi-arid desert country, known as matorral, which is characterised by evergreen scrub plants. Degus survive on limited amounts of water obtained primarily from their food, which comprises scrub foliage, grass and seeds. There is seasonal variation in the water content of plants; in summer the plant foliage dries out and contains just 3–6 per cent water; in winter, foliage contains 70–80 per cent water.) Water intake and efflux were measured by use of the doubly-labelled water technique in degus kept in a secure enclosure within the matorral. Urine osmolality was measured in wild-captured degus using microhaematocrit capillary tubes to obtain samples from the urethra.

***(Note: whereas osmolarity measures the number of osmotically active particles of a particular substance in a volume of fluid, osmolality measures the equivalent number in a mass weight of fluid. For most biological systems the molarity and molality of a solution are nearly exactly equal. For our purposes osmolarity and osmolality can be regarded as* *equivalent.***

2.Pathogenesis. In health, the glomerular filtration barrier functions as a highly organized, semipermeable membrane preventing the passage of the majority of proteins into the urine. This barrier is composed of the glomerular basement membrane, the podocyte, and the slit diaphragm between the podocytes.

Damage to the glomerulus by disease can allow passage through the glomerular filtration barrier of red blood cells, white blood cells, platelets, and blood proteins such as albumin and globulin. Underlying causes for glomerular injury can be inflammatory, toxic or metabolic. These can be seen in the urine (urinalysis) on microscopic and chemical (dipstick) examination. Examples are diabetic kidney disease, glomerulonephritis, and IgA nephropathy.

Due to the connection between the glomerulus and the GFR, the GFR is of clinical significance when suspecting a kidney disease, or when following up a case with known kidney disease, or when risking a development of renal damage such as beginning medications with known nephrotoxicity.