1. **renal function of desert dwellers and the anatomical basis of their unique adaptation**

Hot deserts devoid of drinking water pose significant problems to mammals whose high body temperatures challenge the restriction of evaporative water loss (EWL) in order to maintain water balance, in addition to the obligatory loss of water for excretion. Desert mammals maintain water balance by physiological adaptations that minimise water loss, and by gaining water from food and/or from metabolism that produces oxidation water. Larger desert mammals such as ungulates depend on heterothermy and selective brain cooling to minimise EWL and generally do not excrete highly concentrated urine. Small desert mammals, as exemplified by the rodents, also restrict EWL, but are renowned for their ability to excrete small volumes of very concentrated urine, especially when they do not drink. In addition, the gastrointestinal tract of desert mammals generally has a greater absorptive area for water and nutrient uptake than that of non-desert mammals. To offset water loss, desert mammals gain preformed water from food, and small desert mammals in particular, can produce a significant amount of metabolic water from the oxidative metabolism of food substrates. The latter source of water gives rise to the iconic view of small desert rodents that consume seeds and survive by metabolic water production.

The anatomical structures for urine concentration found in animals living in desert or arid environments, although not all occurring in one particular animal, are wide medullae, long loops of Henle, long proximal tubules, long collecting tubules, small renal corpuscles, extension of the renal pelvis, well developed elongated papillae, occurrence of giant vascular bundles, specialized ultrastructure of Henle's loops, epithelial changes in the collecting tubule, zonation of the vasa recta and peculiarity of the arterial supply to the kidney. The renal renin content is moderately high in these species. The renin-angiotensin-aldosterone system is very active, retaining Na+ with water. The urine is concentrated at the expense of other electrolytes. Both the renal blood and urinary flow rates are lower than in species with access to unlimited water supply. The juxtaglomerular apparatus components are topographically intimate for effective tubuloglomerular autoregulation of renal blood flow.

1. **The clinical importance of the glomerular filtration barrier**

The glomerular filtration barrier is made up of three layers and together they separate the blood inside the glomerular capillaries from the fluid inside Bowman’s capsule.

They work like a sieve, allowing water and some solutes in the plasma like sodium, to pass into Bowman’s space, while keeping red blood cells and plasma proteins in the blood.

Starting from the capillary lumen, the first layer of the glomerular filtration barrier is the endothelium, made up of glomerular capillary endothelial cells.

These cells have fenestrations, which are like pores in the cell themselves, tiny spots where the cytoplasm isn’t filled in so that solutes and proteins can pass right through. But the fenestration are tiny so they block red blood cells from passing through.

Blood minus red blood cells is plasma - so plasma gets to the second layer of the glomerular filtration barrier, which is the basement membrane.

The basement membrane is a gel-like layer with tiny pores and this layer prevents plasma proteins from passing through. That’s because the pores are too tiny for plasma proteins to slip through, and because the basement membrane has a negative electric charge, which repels the negatively charged plasma proteins.

The third layer of the glomerular filtration barrier is the epithelial layer, which is made of special cells called podocytes that wrap around the basement membrane like the tentacles of an octopus. Between these tentacle-like projections are tiny gaps called filtration slits. This third layer works with the basement membrane to block the passage of plasma proteins.