

Excretion in Humans

Excretion:

- removal of excess and toxic substances from the body.
- Waste from chemical reactions.
- Excess water and salt.
- Spent hormones.
- Drugs and other foreign substances.
- Products of chemical reactions can be poisonous.
- Must be removed from the body.

Carbon dioxide: carried away by blood, removed in lungs.

Excess amino acids: deaminated in the liver, forms glycogen + urea.

Urea: removed from tissues by blood, expelled by kidneys.

Hormones-modified in liver, excreted by kidneys.

Nitrogenous waste products, excess water and salt, and spent hormones are excreted by the kidneys as a watery solution called urine.

Excretory organs:

Lungs: get rid of carbon dioxide, lose water vapour - unintentional loss.

Kidneys: remove nitrogenous waste, expel excess water, salt, hormones, drugs.

Skin: excretes waste, salt, traces of urea as sweat. However, they are incidental losses as a result of temperature regulation.

Liver: Deamination- removal of the nitrogen containing part of amino acids to form urea.

Liver plays an important role in assimilating amino acids and builds up amino acids into proteins. The liver also produces waste products urea and bilirubin (breakdown product of haemoglobin, excreted with bile, expelled as faeces).

Need for excretion:

- Chemical reaction byproducts are toxic if they build up.
- Excess CO₂ dissolves in tissue fluid forming carbonic acid which denatures enzymes.

- Ammonia is made in the liver when excess amino acids are broken down. Ammonia is alkaline and toxic.
- Ammonia is converted to urea which can be excreted safely.

Water balance and osmoregulation:

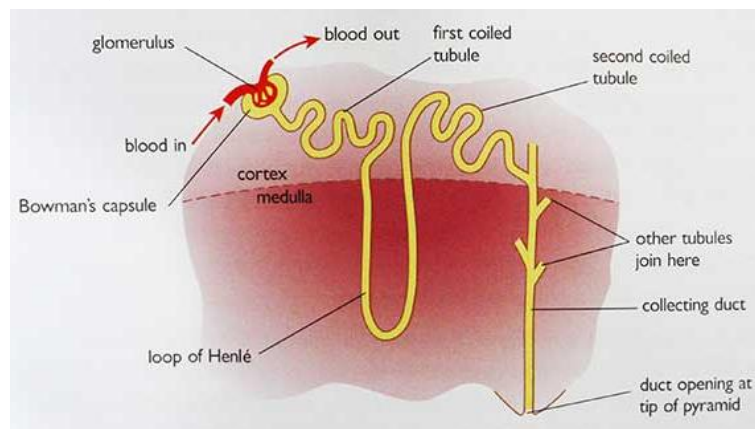
- Water is taken in through food and drink.
- Water is lost through evaporation (sweating), urination, defecation, from lungs as vapour.
- If concentration of body fluids are too dilute, less water is reabsorbed, and a large volume of dilute urine is produced.
- If concentration is too high, a small amount of concentrated urine is produced.
- Depends on temperature, exercise, water intake, water loss through sweat.

The kidneys:

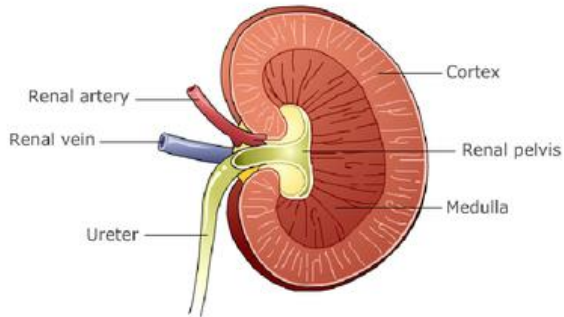
- 2 kidneys - right slightly lower than left.
- Back of the abdominal cavity.
- Renal artery brings blood to the kidneys.
- Renal vein takes blood away from kidneys.
- Tube called a ureter connects the kidney to the bladder.

Nephron:

- Nephron is the functional unit of the kidney.
- Function - ultrafiltration and reabsorption.
- It has a glomerulus (network of capillaries), which is surrounded by a renal capsule which leads to the renal tubule which joins a collecting duct which opens into the pelvis.



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- The kidney has a dark outer region called the cortex which contains the renal capsule.
- The lighter inner zone is called the medulla. The renal tubule leads into the medulla and loops back into the cortex. The collecting duct passes through the medulla.
- The kidney joins the ureter at the pelvis. The collecting duct joins the pelvis.

Process of ultrafiltration:

- The renal artery passes blood into the glomerulus.
- High pressure causes tissue fluid to leak through the capillary walls.
- Glucose, water, salts, urea, uric acid pass into the renal tubule.
- Blood cells and plasma proteins are too large and hence cannot.

Selective reabsorption:

- Glucose, necessary salts, some water, etc. are absorbed back into the bloodstream by osmosis.
- Toxic products, nitrogenous waste, excess water pass through the collecting duct into the pelvis.
- This liquid (urine) passes through the ureter and collects in the bladder.

Bladder:

- Can expand to hold 400cm³ of urine.

- Urine cannot escape because of a band of circular muscles (sphincter).
- When the sphincter relaxes the walls of the bladder expel urine through the urethra.
- When the sphincter contracts, the exit is shut off.
- Adults - sphincter can be controlled.
- Babies - reflex action.

Dialysis:

- If kidneys fail, blood composition has to be regulated with a dialysis machine.
- Consists of a long cellulose tube coiled up in a water bath.
- The water bath has the same concentration of tissue fluid.
- The dialysis machine plays the role of ultrafiltration and selective reabsorption.
- Blood from a patient's arm is led through the dialysis tubing which only allows small molecules (such as glucose, salts, and water) to pass through, blocking blood cells and plasma proteins.
- Only the excess salts and water leave the blood in order to create an osmotic balance with the dialysis fluid.
- The fluid is changed constantly and is kept at body temperature.
- The blood is returned to the arm.
- A patient with total kidney failure requires dialysis 2-3 days a week for upto 5 hours each.

Kidney transplant:

- Patients will not have to undergo constant dialysis.
- Not enough suitable donors.
- Risk of transplanted kidney being rejected.
- Donor may be a close relative or a healthy person who has died. In the second case, the patient's relatives must give their permission for the kidney to be used.

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- Rejection - the transplanted kidney is considered non-self and is attacked by lymphocytes.
- How rejection can be prevented:
 - Tissue of transplanted kidney should be as close as possible, eg. from a close relative.
 - Use of immunosuppressive drugs.

Advantages of kidney transplant compared with dialysis:

- Patients can return to a normal lifestyle.
- Dialysis leaves patients extremely tired.
- Dialysis machines will be available for other patients to use.
- Dialysis machines are expensive to keep and maintain

Image source:

<http://1.bp.blogspot.com/-ai6qVLLxB-8/Vn2E-Wlc-sl/AAAAAAAAAac/FWCsbQuo33o/s1600/c0805.jpg>

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