

Clinical Tract

Module on

The human body and the effect of HIV on the immune system

LEARNING OUTCOMES FOR COUNSELLORS AND DATA CAPTURERS

After completion of this module the learner should be able to:

- Know the names of the most important organs in the body.
- In layman's terms describe the function of the major organs in the body.
- Describe in layman's terms how HIV multiplies.
- Describe how HIV affects the immune system.

EQUIPMENT USED IN MODULE

Human anatomy model

This module is aimed at staff without a medical or technical background to give them some insight into the anatomy and functioning of the human body.

1. THE MAJOR SYSTEMS IN THE BODY

The musculoskeletal system

Bones

The vertebrae are 33 bones that that keeps the body upright. It carries the weight of the body and protects the spinal cord. On top of the vertebrae is the skull and jaw. The skull protects the brain. The ribs are attached to the vertebrae and protect the organs in the chest. The bones of the arms and legs are long bones. The arms attach to the central part of the body through the shoulder girdle. The pelvis joins the vertebrae and legs. The hands and feet are made up of numerous small bones.

Muscles

Muscles contracting and relaxing in a controlled manner cause movement in the arms and legs.

Joints

Joints make movement between the bones possible. The joints are formed by cartilage and synovial fluid that lubricate the joints.

The cardiovascular system

It is the only transport system in the body, responsible to transport nutrients (like oxygen, sugar, vitamins etc.) to every part of the body. It also transports waste products back to where they can be excreted. Examples:

- Urea to the kidneys is excreted as urine
- Old red blood cells to the liver is excreted as bile
- Carbon dioxide (CO₂) to the lungs to be exhaled.

The heart

To achieve the above requires a very sophisticated pump, the heart. The heart is in the chest cavity. It can fill a fair sized swimming pool in a single day! The heart pumps purified blood into the main artery the aorta. The aorta gives off branches to every part of the body, to supply them with nutrients.

The arteries

Inside every body part the main branches of the aorta divide into even smaller vessels called capillaries in order to deliver nutrients to every living cell and fibre in the body.

The veins

On the return side capillaries that have just unloaded their nutrients take up waste products. Several capillaries join to form small veins. These join to form large veins that carry the blood back to the lungs and heart.

Blood

Besides carrying nutrients and waste products (see previous paragraphs), the blood also contains three different types of cells. These are all formed in the bone marrow.

1. Red blood cells that are responsible to carry oxygen and carbon dioxide through the blood.
2. White blood cells to fight off infections.
3. Platelets that play an important role in controlling bleeding.

White blood cells are further divided into neutrophils, lymphocytes, eosinophils, monocytes and basophils. Neutrophils are involved in fighting bacterial infections and lymphocytes fight viral infections. Eosinophils are increased in people with allergies.

The nervous system

It can be compared to a telephone network. It receives impulses (messages) via sensory nerves from the whole body. These are processed in the brain (telephone exchange) before passing the messages on to the outgoing (motor) nerves.

The central nervous system

The brain and spinal cord interpret all the information received from the peripheral nervous system.

The spinal cord is a long column of nerve fibres bundled together. It runs inside the vertebrae from the head to the lower back. The spinal cord conducts signals between the brain and the nervous system. The spinal cord controls simple reflex actions, such as pulling the hand away when touching a hot surface.

The brain has three main parts, namely the brainstem, the cerebrum (the big part of the brain) and the cerebellum).

The peripheral nervous system

The nerves in the different sensory organs collect information and send it to the brain. The sensory organs include the eyes and ears. Pain, touch and temperature are also measured by the sensory organs. Millions of signals are sent to the brain every second.

The motor fibres carry signals from the brain to the muscles.

Forty-three pairs of nerves emerge from the central nervous system – 12 pairs supply the head and 31 pairs supply the rest of the body.

Gastrointestinal system

The mouth

The teeth are responsible to grind the food into smaller pieces. The salivary glands, of which the parotid gland is one, secretes fluids that starts breaking down the food into smaller parts.

The oesophagus

This pipe connects the mouth and stomach and transports the food through the chest.

The stomach

It acts as a reservoir where digestion continues. Small amounts of food are released into the small bowel. Thus: In spite of eating only two or three meals per day, there is a continuous release of food to supply energy for the whole body.

The small bowels (duodenum, jejunum and ileum)

Further digestion takes place and the digested food is absorbed into the blood circulation.

The large bowel (colon)

This acts as a storage space for food waste that is not fit for digestion and absorption. It also absorbs most water from the waste products. This reduces the volume of waste that is stored in the terminal part of the colon and it saves precious water.

The rectum

It is the terminal part of the colon. When the rectum is full it stimulates the urge to go to the toilet.

The liver

It is the most complex organ in the body, with dozens of different functions.

1. It produces bile, which helps with food digestion.
2. It processes toxic substances to make them soluble before excretion (most medicines and alcohol are processed in this way).
3. It stores excess glucose as highly concentrated glycogen. In times of need this glycogen is converted into glucose.
4. All vitamins are stored in the liver.
5. Apart from platelets, all other blood-clotting factors are made in the liver.
6. The liver is the most important organ for making useful proteins that are necessary in the whole body.

Endocrine system

Various endocrine glands secrete important hormones that influence the function of many organs in the body. Glands that secrete hormones include the thyroid and the adrenal glands.

Thyroid hormone determines the rate of activity in the whole body whereas adrenal hormones play an important role during stress.

Reproductive system

The male

Two testes produce the sperm. The testes are situated in the scrotum. The sperm "swim" down the seed tubes and the penis. The role of the prostate is to add some fluid to the ejaculate.

The female

The ovaries produce eggs. The eggs move down the Fallopian tubes to the uterus. The mouth of the uterus is called the cervix. The uterus is connected to the external genital organs by the vagina.

2. THE LIFE CYCLE OF HIV

When HIV enters the body, it attaches itself to the surface of certain white blood cells. These white blood cells all have a receptor or attachment that is called CD4. That is why these cells are CD4 cells, CD4+ lymphocytes or T4 cells. HIV can also attach itself to some cells in the brain.

Once the virus attached itself, it enters the human host cell and starts to replicate itself, using nutrients present in the host cell. For the first step the virus uses an enzyme that is unique to the family the virus belongs to. It is the *reverse transcriptase* enzyme that can multiply the virus hundreds of times. *Protease* is the other enzyme that the virus uses. It helps to weaken the human host cells walls. The virus then buds through its host cell wall into the blood. The new viruses can enter other healthy host cells to multiply once more.

3. HIV AND THE IMMUNE SYSTEM

The immune system is made up of the lymph glands in the body, the tonsils, the spleen, the thymus and the white cells in the blood. They all work in a well-orchestrated manner to control how the body reacts to foreign substances that enters the body. There are many CD4 lymphocytes and other white cells in lymph glands and in the spleen. They are capable of making chemicals (immunoglobulins) that can attach viruses such as HIV. On the other hand, HIV has a liking to enter these same CD4 lymphocyte white cells. The virus inactivates and eventually destroys the lymphocytes. This leads to poor immunity and a low CD4 count. The poor immunity means that many diseases may overwhelm the body because there is no effective defense system.

Examples: candida (thrush) in the mouth and oesophagus, toxoplasmosis in the brain, tuberculosis (TB) in the lungs and brain etc.

