

UNIT 3

Biology and Human Welfare

HUMAN HEALTH AND DISEASE

- **Health** is defined as a state of complete **physical, mental and social well being** and not merely the absence of disease or infirmity.
- Good health is a state of optimum physical fitness, mental maturity and alertness with freedom from anxiety, social well being with freedom from social tensions.
- Health is affected by –
 - **Genetic disorders** - deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth.
 - **Infections** and
 - **Life style** including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.
- When the functioning of one or more organs or systems of the body is adversely affected, characterised by various signs and symptoms, we say that we are not healthy, *i.e.*, we have a **disease**.

COMMON HUMAN DISEASES

- A wide range of organisms belonging to bacteria, viruses, fungi, protozoans, helminths etc. could cause diseases in man. Such disease causing organisms are called **pathogens**.
- Diseases may be broadly classified into two types: acquired and congenital.
- **Congenital diseases** are inborn diseases present from the birth. Acquired diseases occur only after birth and are non-inheritable.
- Two types of acquired diseases are – communicable diseases and non-communicable diseases.
- **Communicable (infectious)** diseases can pass from one infected person to a healthy one. **Non-communicable** diseases remain confined to the persons who develop them and do not spread to others.

Bacterial diseases

Typhoid

- *Salmonella typhi*, a rod like bacterium causes this contagious disease of intestines. The organisms of the disease are present in the stool and urine, therefore, carried by contaminated food and water. Bacterium enters via mouth, line in the intestine and causes lesions in the intestinal walls.

- Incubation period of the bacterium is 1-3 weeks. Sustained high fever (39° to 40°C), weakness, stomach pain, constipation, headache and loss of appetite are some of the common symptoms of this disease. Intestinal perforation and death may occur in severe cases.

- Typhoid fever could be confirmed by **Widal test**.

Pneumonia

- Pneumonia is a serious disease of lungs characterised by accumulation of **mucus/fluid** in alveoli and bronchioles to that extent that breathing becomes difficult. It is caused by *Streptococcus pneumoniae* or *Diplococcus pneumoniae*, and *Haemophilus influenzae*.
- Pneumonia is characterised by high fever, pain in breathing, cough, increased pulse and respiratory rates.
- A healthy person acquires the infection by inhaling the droplets/aerosols released by an infected person or even by sharing glasses and utensils with an infected person. Drugs against pneumonia are erythromycin, tetracycline and sulphonamide. If untreated pneumonia leads to death.

Dysentery

- Dysentery is an infection of the intestinal tract causing severe diarrhoea with blood and mucus.
- **Amoebic dysentery (amoebiasis)** is caused by the protozoan *Entamoeba histolytica*. **Bacillary dysentery** is caused by bacteria of the genus *Shigella* and is spread by contact with a patient or carrier or through food or water contaminated by their faeces.

Plague

- Plague is caused by a rod shaped non-motile bacterium called *Pasteurella/Yersinia pestis* and is transmitted by the bite of infected rat flea *Xenopsylla cheopis*. Plague is also called **black death**.

Diphtheria

- Diphtheria is an acute infectious disease of mostly children, characterised by the development of a grey adherent false membrane over the upper respiratory tract or throat. It is caused by toxigenic strains of *Corynebacterium diphtheriae* (Gram +ve bacterium).
- It is spread through kissing, talking, coughing and sneezing.
- Fever, sore throat, epithelial necrosis by endotoxin and oozing of semisolid material in the throat which develops

into a grey false but tough membrane. The membrane chokes the air passage. Sometimes, bacterium infects the heart leading to fatal heart blockage.

Cholera

- Cholera is a water borne disease.
- This is caused by the bacterium *Vibrio cholerae* which infects intestines and digestive tract.
- It is spread through contaminated food and drinks.
- Cholera is mainly characterised by sudden onset of profuse, effortless, rice-water like stools, vomiting and rapid dehydration, loss of minerals and muscular cramps.

Tetanus (commonly called lock jaw)

- Lock jaw disease is caused by the spores of *Clostridium tetani* that enter through wound. The spores are abundant in the soil manured with animal dung.
- The bacterium secretes a powerful exotoxin **tetanospasmin** into the tissue, and blood carries it to the central nervous system and brings about tetanus of muscles.
- **Incubation period of the bacterium is 3-25 days.**
- The symptoms are painful muscular spasms especially of neck and jaw. Lock jaw condition when the patient cannot open the mouth, convulsions and paralysis of muscles, difficulty in chewing and swallowing, fever and headache.

Tuberculosis or T.B.

- T. B. is caused by *Mycobacterium tuberculosis* and infects any part of the body. It could be bones, brain or lungs and lymph nodes. Lung T.B. is most common. The bacterium releases a toxin **tuberculin** which destroys the tissues it infects.
- It spreads through sneezing, coughing, contaminated food, water or clothes.
- **Incubation period** is 3 to 6 weeks or may be years.
- Constant cough and in severe cases sputum with blood, pain in chest while coughing, loss of body weight and gradual weakening of the body, low grade fever throughout the day are the symptoms of lung T. B.

Viral diseases

Common cold

- Common cold is caused by some 100 types of *Rhino* viruses and small bacterium *Dialister pneumosintes*. It is one of the most common infectious diseases in human.
- Virus infects nose and upper respiratory passage (but not the lungs) causing inflammation of mucous membranes. There is irritation of nasal tract, nasal congestion, flow of mucus, sneezing, sore throat, hoarseness, cough, tiredness, headache and slight fever. It is cured automatically after 3-7 days.
- Droplets resulting from cough or sneezes of an infected person are either inhaled directly or transmitted through contaminated objects and cause infection in a healthy person.

Mumps

- Mumps or infectious parotiditis is caused by a *Paramyxovirus* (RNA virus) or *Myxovirus parotiditis*.

Mumps causes inflammation of the parotid glands behind ears. MMR vaccine is used against measles, mumps and rubella (German measles).

Measles (Rubeola disease)

- Measles is a highly infectious **childhood disease** occurring between 3 - 6 years of age. It is caused by Rubeola virus/ *Polynosa morbillorum*.

Viral hepatitis

- Viral hepatitis is commonly called **jaundice**.
- The symptoms in early phase include - fever, anorexia, nausea, vomiting, epigastric discomfort, pains in muscles and joints.
- The urine is dark and stool is pale. Leukopenia is followed by lymphocytosis. Splenic enlargement is sometimes present. Jaundice increases for 1-2 weeks.
- There are 6 varieties of hepatitis. These are -hepatitis A, hepatitis B, hepatitis C, hepatitis D, hepatitis E, hepatitis G.

Dengue fever (Breakbone fever)

- Dengue fever is caused by an RNA containing **arbo virus** (arthropod borne virus) of *flavi virus* group which also causes yellow fever. Thus, the virus which causes dengue fever is a mosquito borne **flavi-ribo virus**.
- The virus of dengue fever is transmitted by the bite of tiger mosquito, *Aedes aegypti* (mosquito) during day time. Incubation period is of 3 - 8 days.
- Symptoms are
 - Abrupt onset of high fever.
 - Severe frontal headache.
 - Pain behind the eyes which worsens with eye movement.
 - Muscles and joint pains.
 - Loss of sense of taste and appetite.
 - Measles like rash over chest and upper limbs.
 - Nausea and vomiting.

Chikungunya

- It is temporarily debilitating disease caused by **Alpha virus** and spreads through mosquitoes, *Aedes aegypti* and *Aedes albopictus* (Asian tiger mosquito).
- The patient has maculopapular (strain and eruptions) rash of limbs and trunk, and arthritis of multiple joints.
- There is fever which is accompanied by conjunctivitis and photophobia.

Chicken pox

- Chicken pox is caused by *Varicella zoster virus*, a DNA virus, which is passed out in the discharges of the respiratory tract of an infected person directly as droplets or through contaminated articles used by the patient.
- Incubation period is of 14 - 21 days.
- Dew-drop like rash (or pox) on stomach and chest, spreading later on face and the whole body characterize it. Also high fever, itching, aches and uneasiness occurs.

Poliomyelitis

- Poliomyelitis is caused by an Enterovirus, polio virus, (RNA virus) which is one of the smallest known viruses, 10 μm in diameter.
- It enters the body through food or water and multiplies in the cells of the intestinal wall and spreads in nervous system through blood.
- Incubation period is 7 - 14 days.
- It produces inflammation of the nervous system.
- There is inability of bending the head forward, stiffness of the neck, paralysis of skeletal muscles, fever, headache, chilliness and pain all over the body.

Protozoan diseases**African sleeping sickness or trypanosomiasis**

- African sleeping sickness is caused by *Trypanosoma gambiense* by the bite of the blood sucking tse tse fly, *Glossina palpalis*.
- This disease is characterised by swelling of lymphatic glands, irregular recurrent fever followed by general weakness, loss of weight, anaemia, increase in pulse rate and severe headache.
- In due course the patient falls asleep, first at regular intervals and then lies prostrate in coma. Death is always the ultimate fate.

Kala-azar or dum dum fever or visceral leishmaniasis

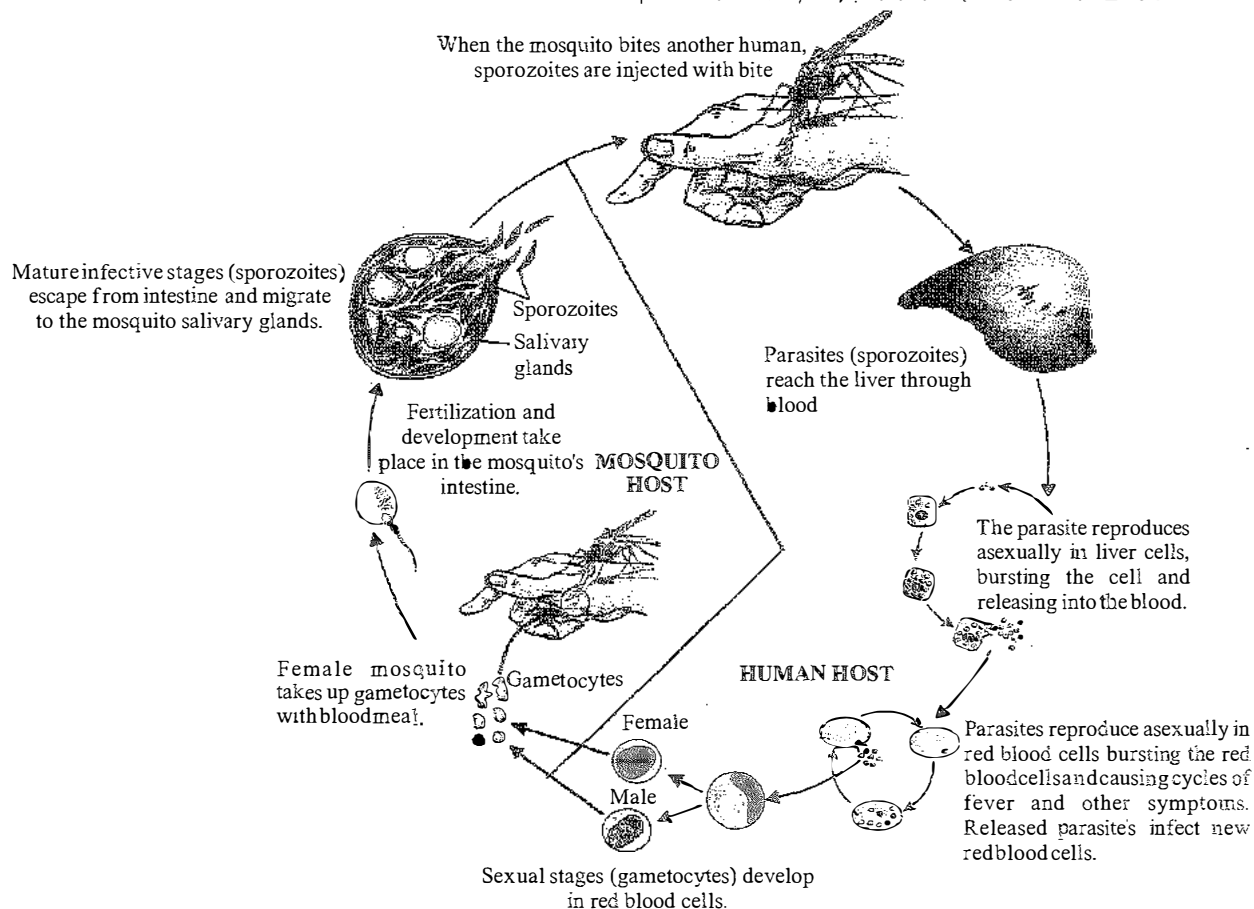
- This disease is caused by the protozoan *Leishmania donovani* through the bite of the sand fly *Phlebotomus*.
- Early symptoms of kala-azar include swelling, high fever and enlargement of spleen and liver, followed by general weakness, emaciation, anaemia due to reduction in number of blood cells, and a peculiar darkening of skin.
- In advanced stage hair becomes brittle and falls out. The body immune system becomes so weak that secondary infections by bacteria or viruses lead to death.

Amoebiasis or Amoebic dysentery

- Amoebiasis is a protozoan infestation of upper part of large intestine which is caused by monogenic protozoan known as *Entamoeba histolytica*.
- Amoebiasis is characterised by abdominal pain, mild diarrhoea alternating with constipation, passing out of mucus, pieces of necrotic mucous membrane and blood in faeces, and faeces with cysts.
- Disease can be prevented by proper sanitation, protection of food from flies, proper washing of vegetables, health education etc.

Malaria

- Malaria is caused by a digenetic (have two hosts to complete its life cycle) and triphasic (having three phases of life cycle) protozoan parasite known as *Plasmodium*.

**Fig.: Life cycle of *Plasmodium***

- Life cycle of *Plasmodium* requires two hosts (**digenetic**) human and mosquitoes for completion.
- The malarial parasite, *Plasmodium* enters the human body as **sporozoites** (infectious form) through the bite of infected female *Anopheles* mosquito (vector). The sporozoites reach the liver cells via blood where they initially multiply. These then attack the red blood cells (RBCs) resulting in their rupturing. The rupture of RBC is associated with the release of **haemozoin**, a toxin which causes the chill and high recurring fever every three to four days.
- The female *Anopheles* mosquito when bites an infected human being, the malarial parasites enter into the mosquito's body and undergo further development to form sporozoites that finally move to the salivary glands of the insect. The bite of these mosquitoes introduces the sporozoites inside the body, thus initiating the above mentioned cyclic process again.
- The attack of malaria is preceded by tiredness, headache and muscular pain. Malaria is characterised by recurring rigors lasting 6-10 hours. There are three stages:
 - **Cold stage** : Chill and shivering.
 - **Hot stage** : Temperature rises to 100°C.
 - **Sweating stage** : There is perspiration and gradual fall in temperature.
- There are four species of *Plasmodium* which causes four main types of malaria in human. They are :
 - *Plasmodium vivax* : Causes **benign tertian malaria** in which fever recurs after every 48 hours.
 - *P. malariae* : Causes **quartan malaria** in which fever appears after every 72 hours, and often produces persistent subclinical malaria.
 - *P. falciparum* : Causes cerebral malaria or malignant tertian malaria where fever recurs after every 48 hours.
 - *P. ovale* : Causes mild tertian malaria.

Helminthic diseases

- Helminths are animals that belong to the phyla **Platyhelminthes** and **Nematoda** (Nemathelminthes). Many parasitic forms of this group, popularly known as parasitic worms, are endoparasites of gut and blood in human body which cause diseases, collectively called helminthiasis.

Ascariasis

- Ascariasis is caused by the common round worm, *Ascaris lumbricoides*. Symptoms of these disease include internal bleeding, muscular pain, fever, anemia and blockage of the intestinal passage.
- Worm sometimes bore the intestinal epithelium and lead to some vital organs like kidneys, spinal cord, brain or muscles causing injuries to the organs. A healthy person acquires infection through contaminated water, vegetables, fruits, etc.

Filariasis or Elephantiasis

- *Wuchereria* (*W. bancrofti* & *W. malayi*), the filarial worms cause a slowly developing chronic inflammation of the

organs in which they live for many years, usually the lymphatic vessels of the lower limbs, and the disease is called filariasis.

- The pathogen spreads from one human being to another through mosquitoes like *Culex* and to a less extent by *Anopheles* and *Aedes*. The parasite resides in **lymph vessels**, **connective tissues** and **mesentery**. It is manifested by lymphoedema accompanied by thickening of subcutaneous tissues and skin so there is permanent swelling mostly of feet, legs, thighs, scrotal sacs, breast, etc. It is called **elephantiasis**. The disease can be prevented by taking precautions against mosquito bites.

Fungal diseases

- The dermatophytes are a group of closely related fungi. They infect the skin, hair and nails. They cause a variety of clinical conditions collectively called as **dermatophytoses**, popularly called **tinea** or **ringworm**.
- Dermatophytes include three genera:
 - **Trichophyton** infecting skin, hair and nails.
 - **Microsporum** which attacks the hair and skin but usually not the nails.
 - **Epidermophyton** infecting the skin and nails but not the hair. Main symptoms of the disease are appearance of dry, scaly lesions on various parts of the body such as skin, nails and scalp. These lesions are accompanied by intense itching.
- Heat and moisture help these fungi to grow in the **skin folds** such as those in the **groin** or between the toes. The infection of ringworms is usually acquired from soil or by using towels, clothes or comb of infected persons.

Non-communicable diseases

- Non-communicable diseases develop in persons suffering from them. These diseases are **non-infectious** as these do not spread from infected persons to healthy one.
- On the basis of their **causative agent**, non-communicable diseases are of the following types – **deficiency**, **degenerative**, **cancerous** and **allergy**.
- **Deficiency diseases** occur due to absence of those factors which are important for body growth and development.
- These are of two types - **hormonal** and **nutritional**.
- **Degenerative diseases** occur due to degenerative changes in some vital organs of the body. These are of following types – like cardiovascular disease, brain disease and arthritis.
- **Allergies** are caused when the body which has become hypersensitive to certain foreign substance, comes in contact with that substance. **Hay fever** is an allergic disease.

Cancer

- Cancer is characterised by uncontrolled proliferation of cells without any differentiation, having ability to invade other tissues or parts of the body.
- Normal cells show a property called **contact inhibition** by virtue of which contact with other cells inhibits their

uncontrolled growth. Cancer cells appear to have lost this property. As a result of this, cancerous cells just continue to divide giving rise to masses of cells called **tumors**.

- All tumors are not cancerous. Tumors may be benign and malignant.
- **Benign tumor** is a large localised mass of abnormal tissue enclosed in connective tissue which does not invade adjacent tissue.
- **Malignant tumor** is not encapsulated and is capable of invading adjacent tissues and distant sites.
- **Metastasis** is a spread of cancerous cells from one part of the body to other parts through blood, lymph and secondary form of malignant tumor. Metastasis is the most feared property of malignant tumors.
- Types of cancers are carcinoma, sarcoma, leukemia and lymphoma.
- **Carcinoma** is a cancer of epithelial tissue and their derivatives like mucous membrane, skin, lungs, breast etc.
- **Sarcoma** is a cancer of primitive mesodermal tissue like connective tissue, bone, muscle, lymph nodes etc.
- **Leukemia** is a blood cancer. It involves the increased WBC count (200,000-1000,000/mm³) of blood due to increased formation in the blood marrow resulting in decreased erythropoiesis and RBC count.
- **Lymphomas** affect the lymphatic system, a network of vessels and nodes that acts as the body's filter.

Causes of cancer

- Chemical and physical agents that can cause cancer are called **carcinogens**. These are
 - Overexposure to **ionising radiations** like X-rays, UV rays, gamma rays etc which literally punches holes in the DNA, breaking the correct genetic sequences.
 - **Chemicals** like nicotine, caffeine, steroids, and arsenic air pollutants causing cancers of lungs, brain, breast or blood.
 - Viruses, which include the human papilloma virus (implicated in cervical cancer), the human T cells lymphocytic virus (implicated in lymphoma), and hepatitis B virus (implicated in liver cancer)
 - **Oncogenes** and **tumour suppressor genes**.
- **Cancer-associated genes** can be divided into the following three categories –
 - Genes that induce cellular proliferation, e.g., genes encoding growth factors, growth factor receptors, transcription factors etc.
 - Genes that inhibit cellular proliferation (**tumour suppressor genes**).
 - Genes that regulate programmed cell death (**apoptosis**).

Possible symptoms of cancer

- These are :
 - A persistent cough or hoarseness in a smoker.
 - A persistent change in digestive and bowel habits.
 - A change in a wart or mole.

- A lump or hard area in the breast.
- Unexpected diminished or lost appetite.
- Unexplained low-grade fever.
- Unexplained loss of weight.
- Any incurable ulcer.
- Bleeding in vagina at times other than menstruation.
- Non-injury bleeding from the surface of the skin, mouth or any other opening of the body.

Detection and diagnosis of cancer

- Techniques such as **radiography** (use of X-rays),
- **CT Scan** (computed tomography), **MRI Scan** (magnetic resonance imaging) are very useful to detect cancers of the internal organs. **Mammography** is radiographic examination of breasts for possible cancer. Bone marrow biopsy and abnormal count of WBCs is used in leukemia.
- **Treatment of cancer** : The common approaches for treatment of cancer are surgery, radiation therapy and immunotherapy.

IMMUNITY

- The system of animal body, which protects it from various infectious agents and cancer, is known as **immune system**.
- The study of body's defence mechanisms against pathogens is called **immunology**. **Edward Jenner (1749 - 1823)** is known as **Father of Immunology**.
- The human immune system comprises lymphoid organs, tissue cells and soluble molecules such as **antibodies**.
- There are two types of lymphoid organs : **primary lymphoid organs** and **secondary lymphoid organs**.
- The primary lymphoid organs are those organs where T lymphocytes and B lymphocytes mature and acquire their antigen specific receptors. For e.g., **thymus** and **bone marrow**.
- The secondary lymphoid organs such as spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.
- **Antigens** are substances which, when introduced into the body, stimulate the production of antibodies. Most antigens are proteins but some are carbohydrates, lipids or nucleic acids.
- Antibodies are **immunoglobulins (Igs)** which are produced in response to antigenic stimulation.

Types of Immunity/Defence mechanisms

- These are of two kinds :
 - **Innate/Inborn/ Non-specific** defence mechanism.
 - **Acquired/ Adaptive /Specific** defence mechanism.

Innate immunity

- Innate immunity is that immunity which is present at the time of birth.

- The non specific defence mechanism is further of two types— **external defence** (or **first line of defence**) and **internal defence** (or **second line of defence**).
- First line of defence comprises physical and chemical barriers to the entry of pathogens into the blood.
- Physical barriers are of **two kinds** – skin and mucous membrane and chemical barriers includes chemicals secreted by skin and mucous membrane like skin secretion, saliva, tears, bile, gastrointestinal secretion, nasal secretion, cerumen, vaginal secretion, etc.
- When the first line of defence fails to prevent access of pathogens to the tissues, the body's second line of defence comes into play.
- The body's internal defence is carried on by white blood corpuscles, macrophages, inflammatory response, fever, interferons and complement system.
- Virus infected cells secrete proteins known as **interferons** which protect non-infected cells from further viral infections.

Acquired immunity

- Acquired immunity is the immunity (also called specific defence mechanism or **third line of defence**) developed by an animal in response to a disease caused by infection of microbes.
- Unique features of acquired immunity are **specificity, diversity, discrimination between self and nonself and memory**.
- The acquired immunity is further of two types – **natural** or **active** and **artificial** or **passive**.
- When a host is exposed to antigens, antibodies are produced in the host body. This type of immunity is called **active immunity**.
- When ready-made antibodies are directly given to protect the body against foreign agents, it is called **passive immunity**. The **colostrum** has abundant antibodies (IgA) to protect the infant. This is an example of **passive immunity**.

Table : Differences between active and passive immunity

	Active immunity	Passive immunity
1.	Exposure to antigen.	No exposure to antigen.
2.	It is developed when the person's own cells produce antibodies in response to infection or vaccine.	It is developed when antibodies produced in other organisms are injected into a person to counteract antigen such as snake venom.
3.	It provides relief only after long period.	It provides immediate relief.
4.	It has no side effects.	It may cause reaction.
5.	It is long lasting.	It is not long lasting.

Immune response

- The specific reactivity induced in a host by an antigenic stimulus is known as the immune response. It is of two types - primary and secondary immune response.
- The reaction of the body's immune system to the first attack of microbes (antigens) is called **primary immune response**. It takes much longer time to develop.

- The reaction of the body's immune system to any subsequent infection of the same microbe is termed **secondary immune response**. This response is quicker and more intense than the primary immune response.
- The primary and secondary immune responses are carried out with the help of two special types of lymphocytes present in our blood. *i.e.*, **B-lymphocytes** and **T-lymphocytes**.
- Lymphocytes that migrate to the thymus and differentiate under its influence are called 'T-cells', while those cells that continue to be in the bone marrow for differentiation are known as 'B-cells'.
- **T-cells** are responsible for **cellular immunity**, however, B-cells produce the antibodies—about 20 trillions per day that take part in the **humoral immunity**.
- The B-lymphocytes and T-lymphocytes form **humoral** or **antibody mediated immune system (AMIS)** and **cell-mediated immune system (CMIS)** respectively.
- When antibodies on a B cell's surface bind antigens, the B cell is activated and divides, producing a clone of daughter B cells. The daughter cells specialise into **plasma B cells** and **memory B cells**.
- Plasma B cells (also known as **effector cells**) are antibody factories.
- Memory B cells live for a long time and serve to quickly dispose of the antigens in case reinfection of the same virus or bacterium occurs.
- The antibodies fight the antigens in five different ways – **neutralization, agglutination, precipitation, opsonization and complement activation**.
- Cell-mediated immunity defends the body against viruses, fungi and some bacteria which have entered the host's cells.
- On stimulation by contact with antigens, the T-lymphocytes produce by division a clone of T-cells, the **lymphoblasts**. There are separate T-cells for each type of antigen that invades the body.
- The T-cells have a life-span of 4 to 5 years or even longer. The T-cells comprising the clone are committed T-cells having specific functions.
- T-cells perform several important functions which can be divided into 2 categories – **regulatory** and **effector**.
- The regulatory functions are mediated by **helper (CD 4 positive) T-cells** which produces **interleukins** and the effector functions are carried out primarily by **cytotoxic (CD 8 positive) T-cells** which kill virus infected cells, tumor cells and allografts.

Immunoglobulin (Ig)/Antibody (Ab)

- Immunoglobulins are **glycoproteins** made up of four polypeptide chains (linked by disulphide bonds)—**two heavy (H)** (440 amino acids) and **two light (L)** (220 amino acids). Light and heavy chains are subdivided into **variables** and **constant region**.

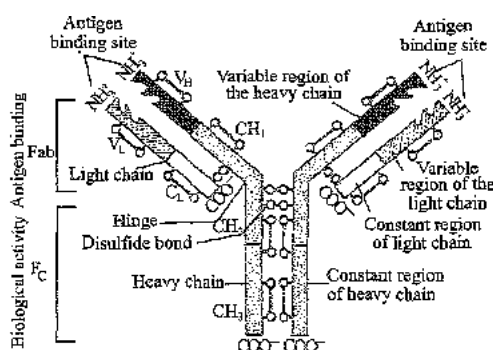
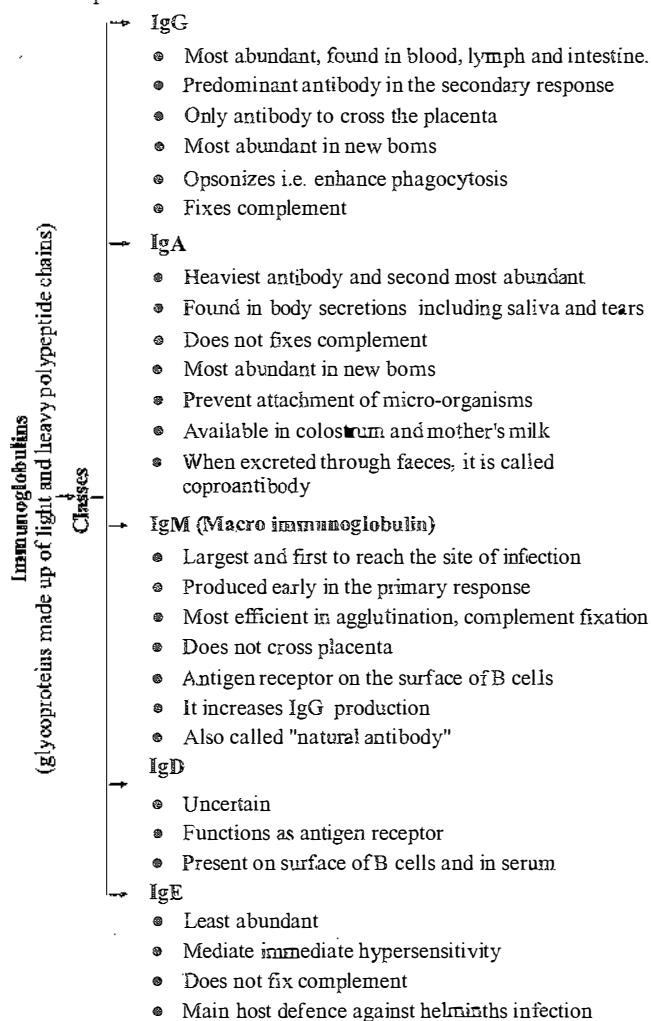


Fig.: Structure of an antibody molecule.

- IgG, IgM, IgA (IgA 1 and 2), IgD and IgE (IgE 1, 2, 3, and 4) are the types of immunoglobulins which are explained in the flow chart below :



Flow chart : Types of immunoglobulins.

Organ transplantation

- It is the implantation of an organ or tissue from one part of the body to another or from one person (donor) to another (recipient).
- Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this the patient has to take immuno-suppressants all his/her life.

- The body is able to differentiate 'self' and 'nonself' and the cell-mediated immune response is responsible for the graft rejection.
- The success of tissue and organ transplants depends on the donor's and recipient's **human leucocyte antigens (HLA)** encoded by the HLA genes. The genes for the HLA proteins are clustered in the **major histocompatibility complex (MHC)**, located on the short arm of chromosome 6.

Vaccination and immunisation

- The principle of immunisation or vaccination is based on the property of 'memory' of immune system. In vaccination, a preparation of antigenic proteins of pathogen or **inactivated/weakened pathogen** (vaccine) are introduced into the body. The antibodies produced in the body against these antigens would neutralise the pathogenic agents during actual infection.
- The **yeast-derived recombinant hepatitis B virus vaccine is the first commercially available human vaccine produced by the genetic engineering technology.**
- Passive immunization is used when exposure to pathogen has already occurred and there is not enough time to induce active protective immunity.
- It involves giving **preformed antibodies** to a person (or animal) in response to vaccination or environmental exposure to the pathogen.

Immunological disorders

- Failure of host defense results into immunological disorders such as allergy (hypersensitivity), autoimmunity, AIDS, etc.

Allergies

- Allergy is inappropriate immune response of a person to harmless substances coming in contact with the body or entering the body from the environment, or in food, or in medicine. The substances which cause allergic reaction are called **allergens**. They are generally weak antigens.
- The common allergic reactions (symptoms) are **inflammation of mucous membranes, sneezing, gasping, running eyes, irritation of upper respiratory tract (throat, trachea), itching, skin rash and many more.**
- Allergy involves mainly **IgE antibodies and histamine**. It causes marked dilation of all the peripheral blood vessels and the capillaries becomes highly permeable so that large amounts of fluid leak out from the blood into the tissues.

Autoimmunity

- Autoimmunity is a condition in which structural or functional damage is produced by the action of immunologically competent cells or antibodies against normal components of the body. It actually implies injury to self.
- Examples of autoimmune diseases are rheumatoid arthritis, insulin-dependent diabetes, chronic anaemia, chronic hepatitis, Hashimoto's disease, etc.

AIDS

- AIDS or **acquired immuno deficiency syndrome** means deficiency of immune system, acquired during the lifetime of an individual indicating that it is not a congenital disease. AIDS is a **disorder of cell mediated immune system of the body**. There is a reduction in the number of **helper T cells** which stimulate antibody production by B-cells. This results in the loss of natural defence against viral infection.
- HIV is a retrovirus that attacks helper T cells. The virus is spherical with a diameter of about 90-120 nm. Its genome consists of a **single-stranded RNA**.
- After the entrance of the virus into the body of the person, the virus enters into macrophages where RNA genome of the virus replicates to form viral DNA with the help of reverse transcriptase enzyme. This viral DNA gets incorporated into the cell's DNA and directs the infected cells to produce viruses.

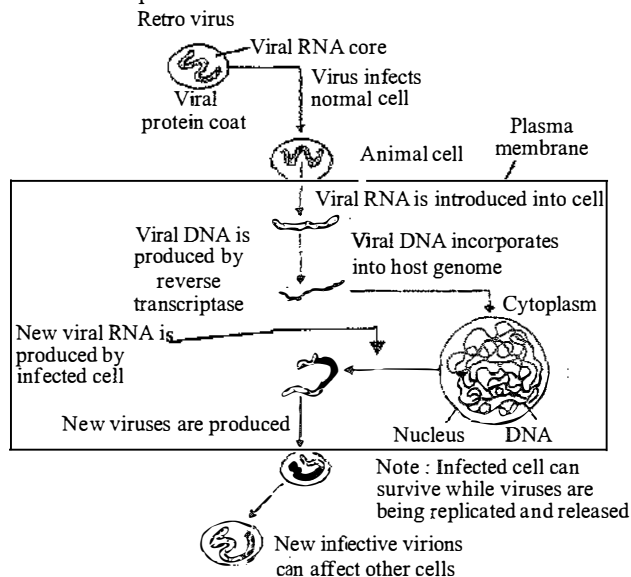


Fig.: Showing mode of action of AIDS virus.

- **Virus of AIDS is transmitted by transfusion** of infected blood or blood products, use of contaminated needles and syringes to inject drugs or vaccines, sexual intercourse with an infected partner without a condom and from infected mother to child through placenta.
- The incubation period of AIDS ranges between **6 months to 10 years**. AIDS can be diagnosed by **ELISA test and Western blotting test**. Western blotting test is employed for confirmation of ELISA positive cases.
- No vaccine has been prepared so far against AIDS virus. The following steps may help in preventing the AIDS :
 - People should be educated about AIDS. Every year, December 1 is recalled as the World AIDS Day. It is one of the methods to educate the people about AIDS.
 - Blood test must be done in blood donors, donors of semen, donors of organs (kidney, lung, liver), patients undergoing haemodialysis and pregnant women.
 - Disposable needles and syringes should be used. Used needles and syringes must be destroyed.
 - In sexual relationship one should be monogamous.
- **NACO** (National AIDS control organisation) and other **NGOs** (Non-government organisations) are doing good work to educate people about AIDS.
- Infection with HIV or having AIDS is something that should not be hidden-since then, the infection may spread to many more people. HIV/AIDS-infected people need help and sympathy instead of being shunned by society.

ADOLESCENCE

- The period of rapid growth, the physical and mental development poised between childhood and adulthood (between 8-18 years for girls and 7-19 years for boys) is called adolescence.
- The period of adolescence **extends from puberty to complete sexual maturity**.
- Addiction to drugs, tobacco and alcohol is also common among adolescents. The main reasons of addiction are curiosity, advertisements, peer pressures, frustration and depression, feeling of independence, false belief of enhanced physical mental/intellectual performance.

DRUG AND ALCOHOL ABUSE

Drug abuse

- **Drug addiction or drug abuse** is taking drugs for purpose other than clinical use, in amount, concentration or frequency that impair physical, physiological and psychological functions of the body.
- Drugs are classified on the basis of their mode of action on brain into two categories –
 - **Psychoactive or psychotropic drugs**
 - **Psychedelic or hallucinogenic drugs**
- Psychoactive or psychotropic drugs are also called as **mood altering or neurological drugs**.
- Psychedelic or hallucinogenic drugs produce psychological effects like illusions and hallucinations.
- Psychotropic drugs act on the brain and alter the behaviour, consciousness and powers of perception.
- Four categories of psychotropic drugs are – sedatives and tranquilizers, opiate narcotics and stimulants.
- **Sedatives and tranquilizers** have a depressing (switching off) effect on the activity of the brain.
- Sedatives may produce a feeling of calmness, relaxation or drowsiness e.g., barbiturates, benzodiazepines, etc.
- In higher dose, sedatives induce deep sleep.
- **Tranquilizers** reduce tension and anxiety without inducing sleep e.g., benzodiazepines, phenothiazines.
- **Opium** is obtained from the unripe seed pods of the poppy plant, *Papaver somniferum*.
- Opium and its derivatives, which include morphine, codeine and heroin are among the drugs collectively known as narcotic drugs.

- **Morphine** has sleep and dream inducing properties.
- **Codeine** is milder than morphine and used in cough syrup.
- **Narcotics** induce addiction if used repeatedly and heroin is the most dangerous narcotic.
- Another opium derivative is **brown sugar**, chemically known as diacetyl-morphine hydrochloride.
- **Stimulants** are also known as 'mood elevators'.
- Stimulants increase nerve activity in the brain by initiating the release of noradrenaline.
- There are two main groups of stimulant drugs: **central nervous system stimulants** (e.g., amphetamine drugs) and **respiratory stimulants** (e.g., analeptic drugs).
- Mildest among the stimulants is **caffeine** which is commonly taken in the form of tea, coffee and cola drinks.
- Caffeinism is caffeine intoxication characterized by restlessness, nervousness, excitement, insomnia, gastrointestinal complaints, etc.
- **Amphetamines** and **cocaine** are strong stimulants.
- Cocaine is obtained from the leaves of *Erythroxylon coca*.
- "**Crack**" is a purified form of cocaine; it can cause seizures and cardiac arrest.
- **Hallucinogens** include certain drugs of abuse, also called **psychedelic drugs**, such as **LSD**, **marijuana**, **mescaline** and **psilocybin**.
- These drugs have a strong effect on cerebrum and sense organs and take the user to a world of fantasy giving him false and temporary happiness.
- **LSD (lysergic acid diethylamide)** is one of the most dangerous hallucinogens of modern times derived from **Ergot fungus**, *Claviceps purpurea*.
- The products of **hemp plant**, *Cannabis sativus*, like bhang, marijuana, ganja, hashish-charas, etc. are other examples of hallucinogens.
- The drug **belladonna** is extracted from the dried leaves and roots of *Atropa belladonna* (family solanaceae).
- Belladonna is a narcotic, diuretic and antispasmodic. Leaves contain **atropine**, used to dilate pupil of eye.
- **Mode of drug action:** Drugs act at the synapses by inhibiting (depressants) or accelerating (stimulants) secretion of **neurotransmitter**.
- Tobacco is used for smoking, chewing and snuffing. Its main stimulating component is a poisonous, volatile alkaloid nicotine, which causes addiction.

Nicotine, in a low concentration

- stimulates conduction of nerve impulses
- relaxes the muscles
- releases adrenaline, increasing heart beat rate and blood pressure
- increased blood pressure due to smoking enhances the risk of heart diseases
- causes cancer of oral cavity, cough and bronchitis, emphysema, stomach disorders, pulmonary tuberculosis, and damage to immune system.
- retards foetal growth in expecting mothers.

- High concentration of nicotine paralyses nerve cells. Other harmful components of tobacco smoke besides the poisonous nicotine are carbon monoxide, polycyclic aromatic hydrocarbons and tar.
- Smoking increases carbon monoxide (CO) content in blood and reduces the concentration of haemoglobin oxygen. This causes oxygen deficiency in the body.

Report of WHO on addiction

According to WHO report, there are some 500 lacs of drugs addicts in the world. Of these, 300 lacs take marijuana, 80 lacs use cocaine, 70 lacs consume opium, 7 lacs take heroin and the rest use other drugs. The above data shows the magnitude of the problem of drug addiction and emphasizes the urgent need for educating the public about the menace of drug addiction. It will be in the fitness of things to have at least one deaddiction centre in each town.

Alcohol abuse

- **Ethanol or ethyl alcohol** is the active constituent of alcoholic drinks such as beer (5 per cent by volume), wine (10 per cent by volume) and whisky (40 per cent by volume).
- **Low level of alcohol** causes facial flushing, talkativeness and increases social confidence.
- **High level of alcohol** causes disturbed thinking, irritability, reduced self-control, slurred speech, drowsiness, difficulty in remaining upright, etc.
- Alcohol **decreases the activity of CNS**, thereby reducing anxiety, tensions and inhibitions.
- Alcohol **decreases the secretion of ADH (anti-diuretic hormone)** from posterior pituitary causing increased urine output.
- Heavy drinkers become dehydrated. Thirst, dry tongue and hangover are associated with effects of alcohol.
- In the liver, alcohol is converted into a more toxic substance, acetaldehyde, which is used by cells for energy.
- Liver synthesises fats from alcohol; the extra fat decreases the production of enzymes and structural proteins.
- The accumulation of fat results in 'fatty liver syndrome' leading to cirrhosis (replacement of liver cells by fibrous tissue).
- Alcohol addiction lowers blood sugar level, adversely affecting the brain.

Driving and drinking

Driving and drinking do not go together as (i) Alcohol makes the drivers erratic, careless, rash, taking unwanted risks. (ii) Drunken drivers lose their alertness. (iii) There is impairment of co-ordination of various body parts like eyes, ears, limbs, head, etc. (iv) Field and clarity of vision are reduced. Power of accommodation is affected - tunnel vision (narrow field of vision and low accommodation) giving blurred and unsteady images. (v) Because of tunnel and blurred vision, distance cannot be judged properly (vi) Alcohol increases reaction time (time between sight and reaction like application of breaks of drivers causing road accidents).

