

HUMAN HEALTH AND DISEASE

HUMAN HEALTH AND DISEASE

- Improper functioning of one or more organs or systems of the body is adversely affected, gives rise to various signs and symptoms i.e we have **disease**.
- Diseases which can easily transmit from one person to other by any means are called **infectious** or **communicable diseases**.
- Diseases which can not be transmitted from one person to another are called **non-infectious** or **non-communicable diseases**.
- Disease causing organisms are said to be **pathogen**.

TYPHOID:

Pathogen: *Salmonella typhi* (bacterium)

Organs affected: small intestine, migrate to other organs through blood.

Method of transmission: contamination of food and water.

Symptoms:

- Sustained high fever (39° to 40° C)
- Weakness, stomach pain, constipation, headache and loss of appetite.
- Intestinal perforation and death may occur.

Test: Typhoid fever could be confirmed by **Widal test**.

PNEUMONIA:

Pathogen: *Streptococcus pneumoniae* and *Haemophilus influenzae*.

Organs affected: Alveoli of lungs, alveoli get filled with fluid.

Method of transmission: inhaling the droplets/aerosols released by infected person. Sharing glasses and other utensils.

Symptoms:

- Fever, chills, cough and headache.
- In severe cases the lips and finger nails turn gray to bluish colour.

COMMON COLD:

Pathogen: Rhino viruses.

Organs affected: nose and respiratory passage

Method of transmission:

- Direct inhalation of droplets from infected person.
- Through contaminated objects like pen, books, cups, computer key board.

Symptoms:

- Nasal congestion and discharge, sore throat, hoarseness, cough.

MALARIA:

Pathogen: *Plasmodium*. (*P. vivax*, *P. malariae*, *P. ovale*, *P. falciparum*)

Malignant malaria caused by **P. falciparum** is fatal.

Organs affected: liver, RBC.

Method of transmission: by biting of female anopheles mosquito (vector)

Symptoms: high fever and chill, fever occurs on every alternate day, vomiting.

life cycle of malaria parasite:

- Life cycle of plasmodium starts with inoculation of **sporozoites** (infective stage) through the bite of infected female *Anopheles* mosquitoes.
- The parasite initially multiplied within the liver cells and then attack the red blood cells (RBCs) resulting in their rupture.
- There is release of a toxic substance called **hemozoin** from the ruptured RBCs which responsible for the **chill and high fever**.
- From the infected human the parasite enters into the body of Anopheles mosquito during biting and sucking blood.
- Further development takes place in the body of Anopheles mosquitoes.
- The female mosquito takes up **gametocytes** with the blood meal.
- Formation of gametes and fertilization takes place in the intestine of mosquito.
- The zygote develops further and forms thousands of sporozoites which migrated into the salivary gland of mosquito.
- When the mosquito bite another human sporozoites are injected.
- The malarial parasite requires two hosts – human and Anopheles, to complete their life cycle.

AMOEBIASIS (Amoebic dysentery)

Pathogen: *Entamoeba histolytica* a protozoan parasite.

Organs affected: large intestine of man

Method of transmission:

- House fly acts as mechanical carrier.
- Contamination water and food with faecal matter.

Symptoms:

- Constipation, abdominal pain and cramps.
- Stools with excess mucous and blood clots.

ASCARIASIS:

Pathogen: *Ascaris lumbricoids* (nematode)

Organs affected: intestine of man

Method of transmission: Contaminated water, vegetables, fruits.

Symptoms:

- Internal bleeding, muscular pain, fever, anemia.
- Blockage of the intestinal passage.

FILARIASIS OR ELEPHANTIASIS:

Pathogen: *Wuchereria* (*W. bancrofti* and *W. Malayi*) (nematode parasite)

Organs affected: lymphatic vessels of the lower limbs, genital organs.

Methods of transmission: biting of infected female culex mosquito.

Symptoms:

- Chronic inflammation of the organs where they live for many years.
- Abnormal swelling of lower limb, scrotum, penis.
- Hence the disease named as **elephantiasis** or **Filariasis**.

RING WORMS:

Pathogen: *Microsporum*, *Trichophyton* and *Epidermophyton* (fungi)

Organs affected: Skin, nails, folds of skin, groin.

Method of transmission:

- Acquired from the soil.
- Using towel, clothes or even comb of infected individuals.

Symptoms:

- Appearance of dry, scaly lesions in skin nails and scalp.
- Lesion accompanied with intense itching.
- **Heat** and **moisture** help these fungi to grow.

PREVENTION AND CONTROL OF INFECTIOUS DISEASES:

- Maintenance of personal and public hygiene is very important for prevention and control of many infectious diseases.
- **Personal hygiene** includes:
 - Consumption of clean drinking water, food vegetable fruits.
 - Keeping the body cleans.
- **Public hygiene** includes:
 - Proper disposal of waste and excreta
 - Periodic cleaning and disinfection of water reservoirs, pools, cesspools.
 - Standard practices of hygiene in public catering.

- In case of **air-borne diseases**, close contact with the infected persons or their belongings should be avoided.

For vector borne diseases

- To control or eliminating the vectors and the breeding places.
- Avoiding stagnation of water in and around residential areas.
- Regular cleaning of household coolers.
- Use of mosquito nets.
- Introducing fishes like **Gambusia** in pond that feeds on mosquito larvae.
- Spraying of insecticides in ditches, drainage area and swamps.
- Window and doors must be fitted with wire mesh.
- All these precautions are use full for vector borne disease like dengue and Chickungunya, malaria and filarial etc.

Immunization:

- By massive immunization there is complete eradication of disease like smallpox.
- Diseases like polio, diphtheria, pneumonia, and tetanus have been controlled in large extent.

IMMUNITY:

- The overall ability of the host to fight the disease causing organism by immune system is called **immunity**.
- There are two types of immunity:
 - Innate Immunity.
 - Acquired Immunity.

Innate (non-specific) immunity:

- Called **inborn immunity**.
- Always available to protect out body.
- This is called the **first line of defense**.
- Consists of various barriers that prevent entry of foreign agents into the body.
- If enters they are quickly killed by some other components of this system.
- Different types of barriers are as follows:

Physical barriers:

- Skin is the main barrier which prevents entry of micro-organism.
- Mucous coating of the epithelium lining of respiratory, gastrointestinal and urinogenital tracts helps in trapping microbes.

Physiological barriers:

- **Acidity** of the stomach kills most ingested microbes.
- **Lysozyme** in tears, saliva, and snot kills bacteria by digesting bacterial wall.
- **Pyrogen** released by WBC raise body temperature to prevents growth of microbes in out body.
- **Interferon** induces antiviral state in non-infected cells.

Phagocytic barrier:

- **Polymorpho-nuclear leukocytes** (PMNL-neutrophils), **macrophages**, and **natural killer cells** in the blood and tissues kill pathogen by **phagocytosis**.

Inflammatory barrier:

- When there is injury to the tissue there is release of histamine and prostaglandins by the mast cells.
- Due to vasodilation there is leakage of vascular fluid containing serum proteins with antibacterial activity.
- Further there is influx of Phagocytic cells into the affected area.

Acquired (specific) immunity:

- It is also known as **adaptive immunity**.
- This immunity developed **after birth** when encountered with pathogen.
- It supplements the immunity provided by the innate immunity.
- Acquired immunity has following **unique features**:
 - **Specificity**: distinguish specific foreign molecules.
 - **Diversity**: recognize vast variety of foreign molecules.
 - **Discrimination between self and non-self**: it is able to recognize and respond to molecules that are foreign or non-self. It will not respond to our own cell or molecules.
 - **Memory**: after responding to the foreign microbes and elimination, this immune system retains the memory of that encounter (**primary immune response**). The second encounter with the same microbe evokes a heightened immune response. (**Secondary immune response**)
- Acquired immunity is carried out by two special types of lymphocytes:
 - **B-lymphocytes**.
 - **T-lymphocytes**.
- The B-lymphocytes produce a group of proteins in response to pathogen into the blood to fight with them called **antibody**.
- T-lymphocytes do not produce antibody but help B-cells to produce them.

Structure of antibody:

- Each antibody has four polypeptide chains.
- Two small chains called light chains.
- Two longer chains called heavy chains.
- Antibody represented as H₂L₂.
- Different classes of antibody produced in our body are IgA, IgM, IgD, IgE and IgG.

AMI vs. CMI:

- Immune response by the B-cells by production of antibody is called **Antibody mediated immune response** or **humoral immune response**.
- Immune response by T-cells is by activation of **cytotoxic killer** cells which detects and destroys the foreign cells and also cancerous cells called **cell mediated immuneresponse**.
- Rejection of organs transplants are due to T-lymphocytes.
- Tissue matching, blood group matching are essential for organ transplantation.
- Even after tissue typing immune-suppressants is required before and after transplantation.

Active immunity:

- When the host is exposed to **antigens**, which may be in the form of living or dead microbes or other proteins, antibodies are produced in the host body.
- Active immunity is slow and takes time to give its full effective response.
- Injecting microbes deliberately during immunization or infection of microbes naturally induce **active immunity**.

Passive immunity:

- Ready made antibodies are directly given to protect the body against foreign agents.
- **Colostrums** of mother contain abundant **antibody (IgA)** to protect the child.
- Foetus receives some antibody (IgG) from mother during pregnancy.

Vaccination and Immunization:

- The principle of immunization or vaccination is based on the property of 'memory, of the immune system.
- In vaccination, a preparation of antigenic protein of pathogen or inactivated/weakened pathogen (vaccine) is introduced into the body.
- The antibodies produced in the body against vaccine, (antigen) would neutralize the pathogenic agents during actual infection.
- The vaccines also generate memory B and T-cells that recognize the pathogen quickly on subsequent exposure.

Passive immunization:

- Preformed antibody or antitoxin injection for specific antigen.
- Injection of antivenin for snake bite to counter the snake venom

Vaccine production:

- Recombinant DNA technology has allowed the production of antigenic polypeptide of pathogen in **bacteria and yeast**.
- Vaccine produced by this approach allows large scale production of antigen for immunization. E.g. **hepatitis-B** produced from yeast.

Allergies:

- The exaggerated response of the immune system to certain antigens present in the environment is called **allergy**.
- The substance to which such immune response is produced is **allergen**.
- **IgE** is produced during allergic reactions.
- Common allergens are dust, pollen, animal dander etc.
- Common symptoms are sneezing, watery eyes, running nose etc.
- Allergy is due to release of **histamine** and **serotonin** from the **mast cells**.
- Drugs like anti-histamine, adrenalin and steroid quickly reduce symptoms of allergy.

Auto immunity:

- Memory based acquired immunity able to distinguish foreign molecules or cells (pathogen) from self-cells.
- Sometimes due to genetic and other unknown reasons the body attacks self cells. This results in damage to the body cells and is called auto-immune disease. E.g. **Rheumatoid arthritis, Multiple sclerosis**.

Immune system in our body:

- The immune system consists of
 - **Lymphoid organs**
 - **Lymphoid tissues**
 - **T and B-cells**.

- **Antibodies.**
-
- Immune system recognizes the foreign antigens, responds to them and remembers them.
 - The immune system also plays important role in:
 - Allergic reaction
 - Auto immune diseases and
 - Organ transplantation.
-
- **Primary lymphoid organs:** bone marrow and thymus, **production and maturation** of lymphocytes take place.
 - **Secondary lymphoid organs:** spleen, tonsil, lymph node, Payer's patches of small intestine and appendix, where **proliferation** and **differentiation** of lymphocyte take place.
 - **Bone marrow** is the main lymphoid organ where all blood cell including lymphocytes are produced.
 - **Thymus** is a bilobed organ located near the heart, beneath the breastbone.
 - B-lymphocytes are produced and matured in bone marrow.
 - T-lymphocytes are produced in bone marrow but matured in thymus.
-
- **The spleen**
 - Large bean shaped organ mainly contain **lymphocytes** and **phagocytes**.
 - Acts as a filter of the blood by trapping blood-borne micro-organisms.
 - Spleen is also serves as the large reservoir of **erythrocytes**.
-
- **Lymph node:**
 - Small solid structure located at different points along the lymphatic system.
 - Traps the micro-organisms or other foreign antigens.
 - Antigen trapped into the lymph node responsible for activation and differentiation of lymphocytes and cause immune response.
-
- **Mucosal associated lymphoid tissues (MALT):**
 - Located within the lining of major tract (respiratory, digestive and urinogenital tracts)
 - It constitutes 50% of lymphoid tissues.

AIDS:

- Stands for **Acquired Immuno Deficiency Syndrome**.
- Deficiency of immune system that acquired during life time and not congenital disease.
- Syndrome means a group of symptoms.
- AIDS was first reported in 1981.
- AIDS is caused by HIV (Human Immuno deficiency Virus)
- HIV is **retrovirus**, having RNA as the genetic material.

Method of transmission:

- Sexual contact with infected persons.
- Transfusion of contaminated blood and blood products.
- Sharing infected needles as intravenous drug user.
- From infected mother to the foetus through placenta.

Life cycle of HIV:

- After getting into the body the HIV enters into **macrophages** or **T-helper** cells.
- The viral RNA genome replicated to form viral DNA with the enzyme called **reverse transcriptase**.
- The viral DNA gets incorporated into the host cell's DNA by an enzyme called **integrase**, and directs the infected cell to produce virus particle.
- The macrophage continues to produce virus and acts as HIV factory.
- Virus released from macrophage attack T-helper cells.
- There is progressive reduction in the number of T-helper cells.
- Due to reduction of T-helper cells the person starts suffering from infections of other virus, fungi and even parasites like *Toxoplasma*.
- The patient becomes immuno deficient and more prone to other disease.

Diagnosis:

- ELISA (**enzyme linked Immuno-sorbent assay**)

Prevention of AIDS:

- AIDS has no cure, prevention is the best option.
- Safe blood for transfusion
- Use of disposable needles
- Free distribution of condoms.
- Prevention of drug abuse
- Advocating safe sex and promoting regular checkup.

CANCER:

- Uncontrolled cell division leads to production of mass of cell called cancer.
- Cancerous cell lost the property of **contact inhibition**.
- Cancerous cell just continue to divide giving rise to masses of cell called **tumors**.
- **Benign tumors:**
 - Normally remain confined to their original location
 - Do not spread to other location.
 - Cause little damage.
- **Malignant tumors:**
 - Mass of proliferating cells called neoplastic or tumor cells.
 - These cells grow very rapidly.
 - Invade and damage surrounding tissues.
 - These cells actively divide and grow; they also starve the normal cells.
 - Cancerous cells escape from the site of origin and moves to distant place by blood, wherever they get lodged make the normal cell cancerous. This property is called **metastasis**.

Causes of cancer:

- Normal cells transformed into cancerous neoplastic cells by physical, chemical and biological agents. These agents are called **carcinogen**.
- **Physical agents:** ionizing radiation like X-rays, gamma rays non-ionizing radiations like UV-rays.
- **Chemical agents:** Tobacco smoke, sodium azide, Methyl ethane sulphonate.
- **Biological agents:**
 - Cancer causing viruses called **oncogenic viruses** have a gene called **viral oncogenes**, induce transformation of neoplastic cells.
 - **Cellular oncogenes** (c-onc) or **proto oncogenes** in normal cells, when activated lead to oncogenic transformation of the normal cells.

Cancer detection and diagnosis:

- Biopsy and histopathological study of the tissues
- Radiography like X-rays, CT (computerized tomography)
- MRI (magnetic resonance Imaging).
- Presence of antibodies against cancer-specific antigen.

Treatment of cancer:

- Surgery
- Radiation therapy
- Immunotherapy
- Chemotherapy
- Cryosurgery
- Laser therapy.
- **α-interferon** a response modifier used to detect the cancer.

DRUGS AND ALCOHOL ABUSE:

Opioid:

- The drugs which bind to specific opioid receptor present in **central nervous system** and **gastrointestinal tract**.
- **Heroin** commonly called **smack**, chemically **diacetylmorphine**.
- It is white, odourless, bitter crystalline compound.
- Obtained by **acetylation of morphine**.
- Extracted from latex of poppy plant ***Papaver somniferum***.
- Generally taken by snorting and injection.
- Heroin is depressant and slows down body function.

Canabinoids:

- Group of chemicals that interact with the cannabinoid receptors of brain.
- Obtained from inflorescence of ***Cannabis sativa***.
- Flower top, leaves and resin of cannabis plant are used in various combinations to produce **marijuana, hashish, charas and ganja**.
- Generally taken by inhalation and oral ingestion
- Effects on **cardiovascular system** of the body.

Cocaine:

- Coca alkaloid or cocaine is obtained from coca plant *Erythroxylum coca*.
- It interferes with transport of neuro-transmitter **dopamine**.
- Cocaine is commonly called as **coke** or **crack** is usually snorted.
- Potent stimulating effect on central nervous system.
- Produces sense of **euphoria** and increased energy.
- Excessive dosage causes **hallucination**.

- Other plants with hallucinogenic properties are :
 - *Atropa belladonna*
 - *Datura*.

- Canabinoids are also being abused by some sportspersons.

Medicinal use of drugs:

- Barbiturates, amphetamines, benzodiazepines, lysergic acid diethyl amide (LSD) used as medicines to help patients cope with mental illnesses, depression and insomnia.
- Morphine is a very effective sedative and painkiller used for surgery patient
- Plant product with hallucinogenic property have used as folk-medicine, religious ceremonies and rituals.

Tobacco:

- It is smoked, chewed or used as a snuff.
- Tobacco contains **nicotine an alkaloid**.
- Nicotine stimulates Adrenal glands to raise blood pressure and increased heart rates.
- Smoking tobacco is associated with cancer of lung, urinary bladder, and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer etc.
- Smoking increased CO content of blood reduce oxygen carrying capacity of hemoglobin.
- Tobacco chewing is associated with cancer of oral cavity.

Adolescence and Drug/Alcohol Abuse:

- The period between 12-18 years of age may thought of an adolescent period.
- Adolescent is a bridge linking childhood and adulthood.
- Curiosity, need for adventure and excitement, and experimentation, are the common cause of drug/alcohol abuse.

Addiction and dependence:

- Addiction is a psychological attachment to certain effects such as euphoria and a temporary feeling of well-being associated with drugs and alcohol.
- With repeated use of drugs the tolerance level of the receptors present in our body increases. Consequently the receptors respond only to higher doses of drugs or alcohol leading to greater intake and **addiction**.
- Use of drugs even once, can be a fore-runner to addiction.
- Dependence is the tendency of the body to manifest a characteristic and unpleasant **withdrawal syndrome** if regular dose of drugs/alcohol is abruptly discontinued.
- Withdrawal syndrome characterized by anxiety, shakiness, nausea and sweating.

Effects of Drug / Alcohol Abuse:

- Immediate effects are reckless behavior, vandalism and violence.

- Excessive doses of drugs may lead to coma and death due to respiratory failure, heart failure or cerebral hemorrhage.
- Warning sign of drug and alcohol abuse among youth include:
 - Drop in academic performance,
 - Unexplained absence from school/college.
 - Lack of interest in personal hygiene
 - Withdrawal, isolation, depression fatigue, aggressive and rebellious behavior.
 - Deteriorating relationship with family and friends.
 - Loss of interest in hobbies.
 - Change in eating and sleeping habits.
 - Fluctuation in weight and appetite.
- Intravenous drug user more prone to acquire infections like AIDS and hepatitis.
- The chronic use of drugs and alcohol damages nervous system and cause of **liver cirrhosis**.
- Use of drug and alcohol during pregnancy affect the foetus.

Prevention and control:

- Avoid undue peer pressure.
- Education and counseling.
- Seeking help from parents and peers.
- Looking for danger signs.
- Seeking professional and medical help.

Abbreviations:

- PMNL : Polymorpho-Nuclear Leukocytes
- CMI : Cell Mediated Immunity
- ELISA : Enzyme Linked Immuno sorbent Assay
- HLA : Human Leukocyte Antigen
- MALT : Mucosal Associated Lymphoid Tissue
- SCID : Severe Combined Immuno Deficiency
- NACO : National AIDS Control Organization
- MRI : Magnetic Resonance Imaging
- CT: computerized tomography.