HUMAN HEALTH AND DISEASES

INTRODUCTION

Health, for a long time, was considered as a state of body and mind where there was a balance of certain 'humors'.

This is what early Greeks like Hippocrates as well as Indian Ayurveda system of medicine asserted. It was thought that persons with 'blackbile' belonged to hot personality and would have fevers. The is idea was arrived at bv'pure reflective thought.

The discovery of blood circulation by William Harvey using experimental method and the demonstration of normal body temperature in persons with blackbile using thermometer disproved the 'good humor hypothesis' of health.

In later years, biology stated that mind influencesm, through neural system and endocrine system our immune system and that our immune system maintains our health. Hence mind and mental state can affect our health.

Of course, health is affected byill

(i) **genetic disorders-** deficiencies with which a child is born and deficiencies/defects which the child inherits from parents from birth:

(ii) **infections**

(iii) **life style** including food and water we take, rest and exercise we give to our bodies, habits that we have or lack etc.

The term health is very frequently used by everybody. How do we define if ? Health does not simply mean 'absence of disease' or 'physical fitness'. It could be defined as a state of complete physical, mental and social well-being. When people are healthy, they are more efficient at work. This increases productivity and brings economic prosperity. Health also increases longevity of people and reduces infant and maternal mortality.

Balanced diet, personal hygiene and regular exercise are very important to maintain good health. Yoga has been practised since time immemorial to achieve physical and mental health.

Awareness about diseases and their effect on different bodily functions, vaccination (immunisation) against infectious diseases, proper disposal of wastes, control of vectors and maintenance of hygienic food and water resources are necessary for achieving good health.

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. Diseases can be broadly grouped into infectious and non-infectious. Diseases which are easily transmitted from one person to another, are called infectious diseases.

Infectious diseases are very common and every one of us suffers from these at sometime or other. Some of the infectious diseases like AIDS are fatal. Among non-infectious diseases. cancer is the major cause of death. Drug and alcohol abuse also affect our health adversely.

Some terms related to immunity :

(1) **Immunity : Resistance** of the body against a pathogen or disease.

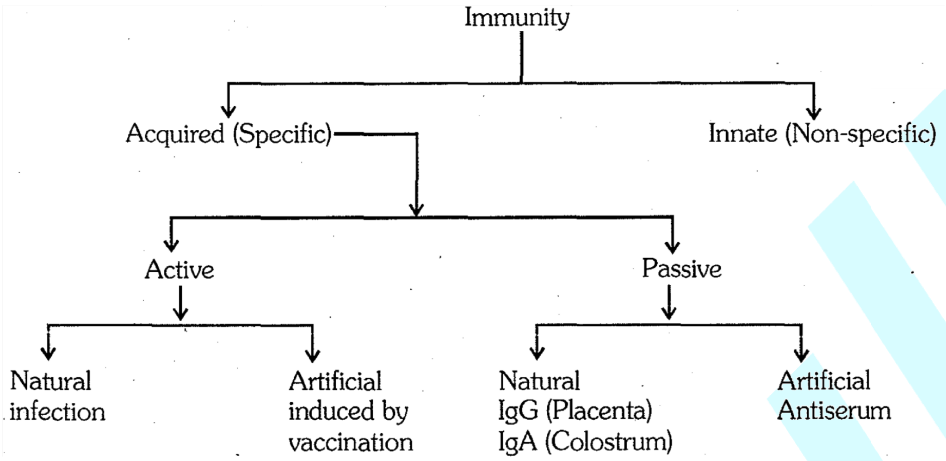
(2) **Antigen or Agglutinogen :** Substance which stimulates the production of antibodies.

(3) **Antibody or Agglutinin :** It is a complex glycoprotein secreted by B-lymphoeytes in response to an antigen.

(4) **Antiserum :** Serum of any animal which contains the antibody for a specific antigen is called antiserum.

(5) **Venom (poison):** Toxic substances secreted by snake and some insect.

(6) **Agglutination :** Antigen antibody reaction is called agglutination and study of antigen-antibody reaction is called serology.



IMMUNITY

Everyday we are exposed to large number of infectious agents. However, only a few of these exposures result in disease. Why? This is due to the fact that the body is able to defend itself from most of these foreign agents. This overall ability of the host to fight the disease-causing organisms, conferred by the immune system is called immunity.

Immunity is of two types:

(i) Innate immunity
(ii) Acquired immunity.

INNATE IMMUNITY

Innate immunity is non-specific type of defence, that is present at the time of birth. This is accomplished by providing different types of barriers to the entry of the foreign agents into our body. Innate immunity consist of four types of barriers. These are:-

(1) **Physical/ Anatomical Barrier:** It is made up of two parts:-

(i) **Skin :** Skin on our body is the main barrier which prevents entry of the micro-organisms. Outermost layer of skin is dead (str. corneum), so the bacteria do not grow or enter into it. pH of skin (3 to 5) destroy the bacteria.

(ii) **Mucosa :** Mucus coating of epithelium lining of the respiratory, gastrointestinal and urogenital tracts also help in trapping microbes entering our body. Mucosa· contain mucosal cells and cilia. Mucosa entraps the micro-organism and cilia propel the microbes.

(2) **Physiological Barriers :** Some physiological processes of body create adverse environment for growth of bacteria. Acid in the stomach, saliva in the mouth, tears from eyes-all prevent microbial growth.

(i) **Fever :** High temperature of body, inhibit the growth of microbes.

(ii) **pH of body :** Acidic pH of various part of body like oral cavity, stomach and vagina inhibit the growth of microbes.

(iii) **Secretions :** Secretions of body like eyes, sebum contain lysozyme, this enzyme destroys the microbes.

(3) Cellular Barrier:-

Polymorpho-nuclear leukocytes (PMNL-neutrophils), monocytes and natural killer cells (type of lymphocytes) in the blood as well as macrophages in tissues can phagocytose and destroy microbes.

(A) Phagocytic Cells - (e.g. Monocytes. PMNL – neutrophil, Macrophage), In response to pathogenic infection, the total count of WBC in body increases. Phagocytosis is exhibited by some types of WBC's such WBC's are called phagocytes.

Most important phagocytes are macrophages and neutrophils. Monocytes are liberated at the site of infection these later converted into macrophages.

Macrophages are large irregular shaped cells that engulf microbes, virus, cellular debris etc. In response to an infection.

(B) Non-Phagocytic cells : (Eg : Natural Killer Cell)

It is a large granular lymphocyte cell. During this process apart from the phagocytes, another type of cells called Natural killer cells kill virus infected cells and tumour cells of body by creating perforin lined pores in the plasma membrane of target cells (i.e. infected cells). Water enters through these pores causing swelling and bursting of the diseased cells.

(4) Cytokine Barriers: Virus-infected cells secrete proteins called interferons which protectnon-infected cells from further viral infection.

Interferon are anti-viral protein made up to 270 amino acids secreated by virus infected cells and stimulates the adjacent cells to produce the Translation Inhibiting Protein (T.I.P.)

By this mechanism interferon limits the infection of virus.

Interferons are species specific i.e. interferons produced by one species can protect only cells of same species against viral infection.

Interferons make cells resistant to viral infection by synthesis of antiviral proteins in that cell.

Interferons can be used for prophylaxis and treatment of viral infections.

INFs - α = activate immune system and destroy tumor. It has shown some success in causing of regression of Kaposi sarcoma in AIDS patients.

Inflammation : Local response of living mammalian tissue to injury due to any agent. It is the body defence reaction in order to eliminate or limit the spread of infectious agent. Inflammation is characterised by -

(i) Redness (Rubor/Erythema) - due to vasodilation.

(ii) Heat (Calor) - metabolic reactions proceed more rapidly.

(iii) Swelling (Tumor) - due to increased permeability of blood vessels.

(iv) Pain (Dolor) - resJllts from injury to neurons and chemicals released by damaged cells (eg. prostaglandins) .

ACQUIRED IMMUNITY

Acquired immunity, on the other hand, is pathogen specific. It is characterised by memory. This means that our body when it encounters a pathogen for the first time produces a response called primary response which is of low intensity. Subsequent encounter with the same pathogen elicits a highly intensified secondary or anamnestic response. This is ascribed to the fact that our body appears to have memory of the first encounter.

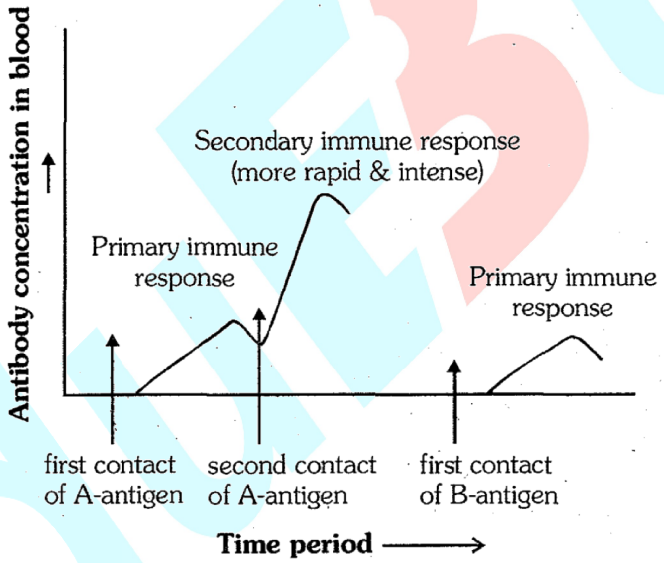
Features of Acquired immunity :

(i) **Specificity :** Acquired immunity is specific for specific micro-organisms.

(ii) **Diversity :** This system recognise the vast variety of micro-organisms.

(iii) **Discrimination between self and non-self.** It can recognise self (body or tissue) and non self (foreign tissue) and respond according to them.

(iv) **Memory :** When a pathogen enter inside the body, body takes longer times to recognise and respond to it this is ca'l led primary immune response but the memory of this encounter remain in immune system. When similar pathogen enters second time inside the body, body immune system rapidly recognises the pathogen and responds quickly to it. This is called secondary (Anamnestic) immune response. This is based on memory of immune system.



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. The B-lymphoces produce an army of proteins in response to pathogens into our blood to fight with them. These proteins are called antibodies. The T-cells themselves do not secrete antibodies but help B cells, to produce them.

ACTIVE AND PASSIVE IMMUNITY

- When a 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. This type of immunity is called active immunity. Active immunity is slow and takes time to give its full effective response. Injecting

the microbes deliberately during immunisation or infectious organisms gaining access into body during natural infection induce active immunity.

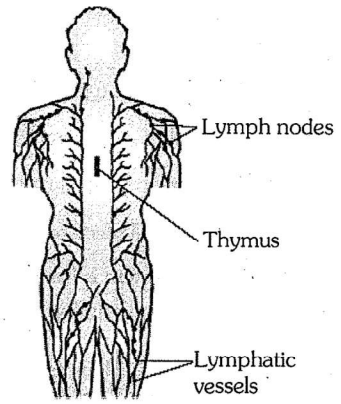
- When ready-made antibodies are directly given to protect the body against foreign agents, it is called passive immunity.
- Do vou know whvmother's milk is considered velJI essential for the newborn infant? The yellowish fluid colostrums secreted by mother during the initial days of lactation has abundant antibodies figA) to protect the infant.
- The foetus also receives some antibodies from their mother, through the placenta during pregnancy. These are some examples of passive immunity.

Difference between active and passive immunity

S. No.	Active immunity	Passive immunity
1.	Produced actively by the immune system of host.	Received passively by the host and the host's immune system does not participate.
2.	Induced by infection or by contacts with immunogen, e.g. vaccines.	Conferred by introduction of ready-made antibodies.
3.	Immune response-durable and effective.	Immune response-short lived and less effective.
4.	Immunity develops only after a lag period.	Immunity effective immediately.
5.	Immunological memory present.	No immunological memory.
6.	Serves no purpose in immunodeficient host.	Applicable in immunodeficient host.
7.	Used for prophylaxis to increase body resistance.	Used for treatment of acute infection.

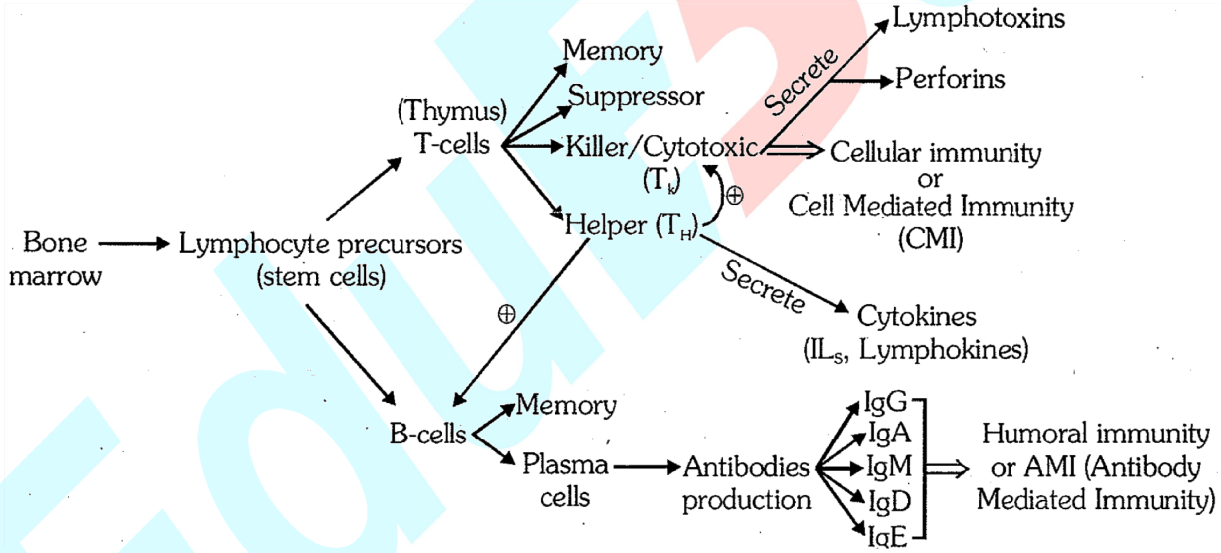
IMMUNE SYSTEM IN THE BODY

- The human immune system consists of
  (i) lymphoid organs
  (ii) lymphoid tissues
  (iii) cells (lymphocytes)
  (iv) soluble molecules like antibodies.
- As you have read, immune system is unique in the sense that it recognises foreign antigens. responds to these and remembers them. The immune system also plays an important role in allergic reactions, auto-immune diseases and organ transplantation.
- Lymphoid organs are the organs where origin and/or maturation and proliferation of lymphocytes occur.
- The primary lymphoid organs are bone marrow and thymus where immature lymphocytes differentiate into antigen-sensitive lymphocytes.



Diagrammatic representation of Lymph nodes

- After maturation the lymphocytes migrate to secondary lymphoid organs like spleen, lymph nodes, tonsils, Peyer's patches of small intestine and appendix. The secondary lymphoid organs provide the sites for interaction of lymphocytes with the antigen, which then proliferate to become effector cells.
- The bone marrow is the main lymphoid organ where all blood cells including lymphocytes are produced.
- The thymus is a lobed organ located near the heart and beneath the breastbone. The thymus is quite large at the time of birth but keeps reducing in size with age and by the time puberty is attained it reduces to a very small size. Both bone-marrow and thymus provide micro-environments, for the development and maturation of T-lymphocytes.
- The spleen is a large beanshaped organ. It mainly contains lymphocytes and phagocytes. It acts as a filter of the blood by-trapping blood-borne microorganisms. Spleen also has a large reservoir of erythrocytes.
- The lymph nodes are small solid structures located at different points along the lymphatic system. Lymph nodes serve to trap the micro-organisms or other antigens, which happen to get into the lymph and tissue fluid. Antigens trapped in the lymph nodes are responsible for the activation of lymphocytes present there and cause the immune response.
- There is lymphoid tissue also located within the lining of the major tracts (respiratory, digestive and urogenital tracts) called mucosal associated lymphoid tissue (MALT). It constitutes about 50 per cent of the lymphoid tissue in human body.



Based on these two type of lymphocytes there are two types of active immune system.

(1) CMIS (Cell mediated immune system) or Cellular immunity (T-cells)

(2) AMIS (Antybody mediated immune system) or humoral immunity (B-cells)

(1) **C.M.I.S.** → Cell mediated immune system or Cellular immunity

This immune system is based on T-cells. (60-70%)

There are 4 type ofT-cell

(i) Helper T-cell (ii) Killer T -cell or cytotoxic T -cell

(iii) Suppressor T-cell (iv) Memory T-cell

When pathogens enter inside the body first macrophage interact with them and activates T_H - cell by releasing cytokines or interleukins (ILs) or monokines.

(i) **Helper T-cell** → This activated helper cell stimulates the killer T-cell and B-cell and these killer T-cell & B-cell start dividing and produce clone (group of similar cells) this phenomenon is called clonal selection. They produce lymphokines (messenger molecules) which cause accumulation of WBCs to the affected site. T_H-cells also stimulate B-cells to produce antibodies and facillitate the action of other T-cells.

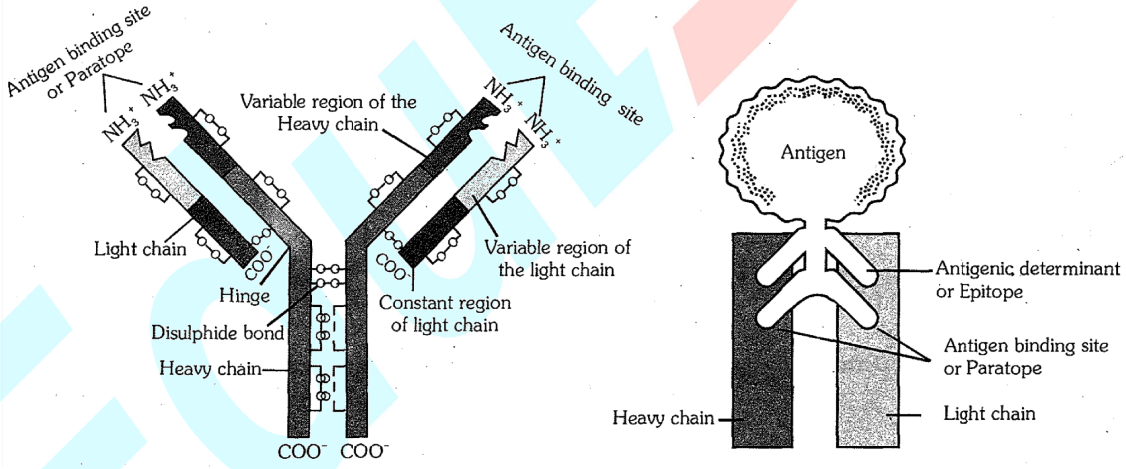
(ii) **Killer T-cell :** These cell or clone of these cell destroy the infected cells or target cell and kill the pathogeri and also the cancerous cells by secreting lymphotoxic substances and secrete lymphokines which attracts phagocytes. These are responsible for cell-mediated immunity. They also destroy transplanted, tumour cells and other foreign cells.

(iii) **Suppressor cells (T_S)** → These suppress the functions of T_C and T_H cells. B-cells and plasma cells are also affected by Ts cells by synthesizing suppressor factors and suppress the entire immune system for attacking the own body

(iv) **Memory T-cell :** They don't kill the pathogen or don't form the antibodies but these cell retain the memory of every encounter. They convert into effector cells on later encounter with specific antigen even after several years.

- **Antigen Presenting Cells :-** In immune mechanism every antigen molecule is processed by antigen presenting cells like macrophages, B-lymphocytes etc. This processed antigen is presented on the surface of these cells. When aT- helper lymphocyte passes closely by the side ofthe antigen presenting cell bearing the antigen on its surface, it recognise the antigen and become activated. Now T-helper cells activate the B-cells and T-killer cells. These cells in turn develop clones by frequent divisions in themselves.

(2) **A.M.I.S.** (Antibody mediated immune system or humoral immunity)



This immune system is based on B-lymphocytes (10-20%) and these B-lymphocytes secrete the antibodies.

Antibody or Immunoglobulin : These are complex glycoprotein molecule made up of 4 polypeptide chains, two light and two heavy chains.

These two chains are held together by disulphide bond in shape of Y, molecule is represented as H_2L_2. Two top tips of this molecule bind with antigen [large and complex foreign molecules mainly proteins that activate the specific immunity] like lock and key fashion and make antigen-antibody complex.

Function of Antibodies

(i) **Agglutination :** Antibody attach with the antigen which is present on the surface of pathogen and destroy the pathogen by cell lysis.

(ii) **Opsonisation :** Coating of bacteria (Ag) with opsonin antibody (IgG and IgM) facilitates the phagocytes cells and these antibodies or opsonin promote phagocytosis by combination with antigen.

(iii) Neutralization : Antibodies neutralize the toxin of bacteria by attaching with them.

IgG	-	Protects body fluids.
IgA	-	Protects body surfaces.
IgM	-	Protects body blood stream.
IgE	-	Mediates regional hypersensitivity.
IgD	-	Activation of B-lymphocyte

First line of defence : Skin, Mucous membrane

Second line of defence: Neutrophils, Monocytes, Macrophage, interferon, fever.

Third line of defence : Specific immunity by T- and B-lymphocytes

TYPE OF ANTIBODIES

S. No.	Group of Antibodies	Total Quantity (%)	Main Characters and occurrence	Functions
1.	IgA	10	The primary antibodies present in colostrum, also present in saliva, mucus, sweat, tears etc., M.W. 1,70,000	Protection of mucous membranes and outer surface of body and protection from inhaled ingested pathogens.
2.	IgD	1-3	Present in trace amount on the surface of lymphocytes in blood, M.W 1,85,000	Activation of B-lymphhocytes and development and matu-ration of immune reactions.
3.	IgE	0.05	Present in very small quantities, show specific linkage with mast cells and basophils, M.W. 1,88,000	Stimulation of mast cells, related to allergic reactions and protection from parasites.
4.	IgG	75-80	Most abundantly found antibodies main immunoglobulin of blood and interstitial fluid which has capacity to pass through placenta, M.W.1,46,000 (lightest)	To provide immune power to human embryo and specific linkage with phagocytic cells for phagocytosis.
5.	IgM	5-10	Oldest and first antibody generated in response to antigens, present in blood plasma (80%) and largest sized immunoglobulin with pentameric form, M.W. 9,60,000 (heaviest)	First antibody generated at the time of defence, strong agglutination.

GOLDEN KEY POINTS

- Good humour hypothesis was disproved by William Harvey.
- Health is a state of complete physical, mental and social well being.
- Interferous are secreted by virus infected cell.
- Natural killer cell is a non phagocytic large granular lymphocyte.
- α-IFN activate immune system and destroy tumour.
- Acquired immunity is characterised bymemory.
- The T-cells themselves do not secrete antibodies but help B cells produce them.
- MALT constitutes about 50 percent of the total lymphoid tissue in human body.

BEGINNER'S BOX-1

IMMUNITY

1. Health includes:
   (1) Complete physical (2) Complete mental well being
   (3) Complete social well being (4) All of the above

2. The light chain and heavy chain of antibody are joined with the help of:-
   (1) H-H bond (2) s-s bond (3) Ionic bond (4) Phosphodiester bond

3. Colostrum is rich in :
   (1) lgA (2) lgG (3) lgE (4)1gM

4. Fever, pH and body secretions are included in which of the following barrier :-
   (1) Physical (2) Cellular (3) Cytokine (4) Physiological

5. Which of the following are the properties of acquired immunity?
   (1) Specificity (2) Diversity
   (3) Immunological memory (4) All of the above

VACCINATION AND IMMUNISATION

Vaccine is suspension of attenuated/inactivated pathogens or antigenic protein of pathogen which is taken orally or injected to provide immunity for that pathogen.

History:

(i) **Edward Jenner, 1796 (Father of immunity)** noticed th?t milkmaid did not suffer from small pox but they had scabs of cow pox. He transport the material from sore of milkmaid who was suffering from cow pox to the young boy of 8 year old. After sometim~ he injected live small pox material into that boy. But symptoms of disease did not appear. He tried this procedure on other person and got success. He gave the term vaccination for this process.

(ii) **Louis Pasture :** He discovered the process of inactivating the pathogen & prepared vaccines for Chicken cholera, Anthrax & Rabies.

(iii) **Von Behring :** He discovered the process of passive immunization and. prepared the antidiphtherial serum (ADS) by injecting diphtheria antigen into sheep. Von Behring is known as 'Father of passive immunization'.

The principle of immunisation or vaccination is based on the property of 'memory' of the 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 vaccines also generate memory-Band T-cells that recognise the pathogen quickly on subsequent exposure and overwhelm the invaders with a massive production of antibodies.

If a person is infected with some deadly microbes to which quick immune response is required as in tetanus, we need to directly inject the preformed antibodies, or antitoxin (a preparation containing antibodies to the toxin). Even in cases of snakebites, the injection which is given to the patients contain preformed antibodies against the snake venom. This type of immunisation is called passive immunisation.

Recombinant DNA technology has allowed the production of antigenic polypeptides of pathogen in bacteria or yeast. Vaccines produced using this approach allow large scale production and hence greater availability for immunisation, e.g .. Hepatitis-8 vaccine produced from transgenic yeast.

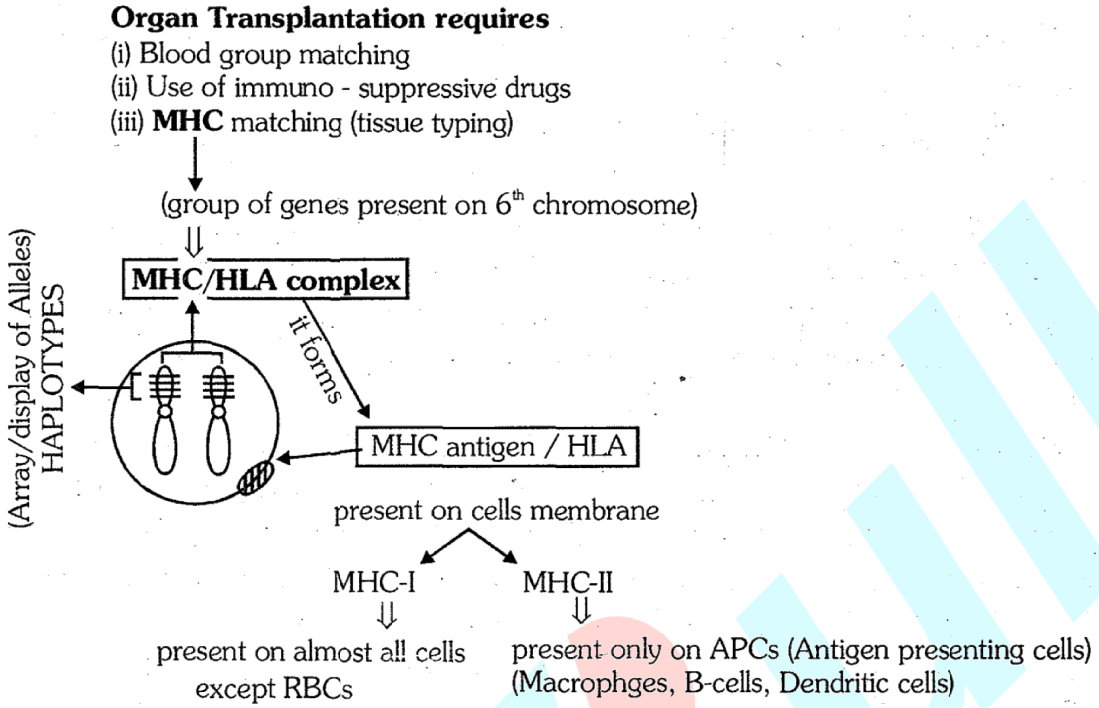
TYPES OF VACCINES

Live vaccines (Natural/Attenuated)	Killed Vaccines (Inactivated)	Toxoids Vaccines (Subunit Vaccine)	Recombinant Antigen Vaccines (Subunit Vaccine)
• Small pox • Rota virus • BCG (Bacillus Calmette Guerin) • OPV (Oral Polio Vaccine, Sabin Type 1) • MMR (Measles, Mumps, Rubella)	• Salk polio (IPV) • Whooping cough (Pertussis) • TAB for Typhoid • Rabies • Influenza • Pneumonia • Cholera	• Tetanus (TT) • Diphtheria (DT) • Botulism	• Hepatitis-B

HLA SYSTEM

- Human leucocyte antigens (HLA) were first discovered on leucocytes. Out of the various genes for histocompatibility antigens, most of the transplantation genes are located on a portion of chromosome-6. These are called MHC (Major Histocompatibility Complex) or HLA complex. The recepients immune system can recognize the histocompatibility antigens on the donor organ and accordingly accept or reject it.
- The array of HLA alleles on a homologue of our chromosome 6 is known as a haplotype. An individual inherits one HLA haplotype from each parent.
- Only identical twins can have identical haplotype.
- The best HLA matching can be observed within the same family.

Tissue Typing :- The procedure carried but to match HLA proteins of donor and recepient.



TISSUE AGRAFTING / ORGAN TRANSPLANTATION

- This is based on HLA (Human Leucocyte antigen) complex or MHC (Major Histocompatibilty Complex). Tissue typing is done before tissue grafting.
- Most of genes of this antigen is present on sixth chromosomes.
- Cyclosporin-A drug is used as a immunosuppresant drug during tissue grafting.

Type of Tissue Grafting -

(i) **Autograft :** Transplantation of tissue from one body part into another body part of an individual. (most successful)

(ii) **Isograft :** Transplantation of tissue in between the individual of same genetic constitution.
Ex. - Identical twins/monozygotic twins

(iii) **Homo or Allograft :** Tissue grafting in between the genetically dissimilar individual of the same species. e.g. Family members (intra species graft).

(iv) **Hetero or Xenograft :** Tissue grafting in between organism of different species.

Successful graft order :- Self > Identical twins> Siblings > Parents > Unrelated donors.

Very often, when some human organs llke heart, eye, liver, kidney fail to function satisfactorily, transplantation is the only remedy to enable the patient to live a normal life. Then a search begins- to find a suitable donor. Why is it that the organs cannot be taken from just anybody? What is it that the doctors check? Grafts from just any source - an animal, another primate, or any human beings cannot be made since the grafts would be rejected sooner or later. Tissue matching, blood group matching are essential before undertaking any graft/transplant and even after this the patient has to take immunosuppresants 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.

GOLDEN KEY POINTS

- The principle of immunisation or vaccination is based on the property of 'memory' of the immune system.
- Tissue grafting in between genetically dissimilar individual of the same species called as allograft.
- Tissue matching, blood group matching are essential before undertaking any graft/transplant.
- The recepients immune system can recognize the histocompatibility antigens on the donor organ and accordingly accept or reject it.

BEGINNER'S BOX-2

GRAFTING AND VACCINES

1. Vaccine is included in :-
   (1) Natural passive acquired immunity (2) Natural active acquired immunity
   (3) Artificial active acquired immunity (4) Artificial passive acquired immunity

2. MHC-11 is present on :-
   (1) Macrophage (2) B-lymphocytes (3) Dendritic cells (4) All of the above

3. Tissue matching is required in which of the following :-
   (1) Homograft (2) Autograft (3) Allograft (4) Both (1) and (3)

4. 'BCG' vaccine is example of :
   (1) Killed vaccine (2) Live attenuated vaccine
   (3) Toxoid (4) All of the above

5. Which type of immunity is responsible for rejection of graft ?
   (1) Innate immunity (2) Humoral immunity
   (3) Antibody mediated immunity (4) Cell mediated immunity

IMMUNE SYSTEM DISORDERS

(A) ALLERGIES

- When you have gone to a new place and suddenly you started sneezing, wheezing for no explained reason, and when you went away, your symptoms dissappeared. Did this happen to you? Some of us are sensitive to some particles in the environment. The above-mentioned reaction could be because of allergy to pollen, mites, etc., which are different in different places.
- The exaggerated response of the immune system to certain antigens present in the environment is called allergy. The substances to which such an immune response is produced are called allergens. The antibodies produced to these are of lgE type. Common examples of allergens are mites in dust, pollens, animal dander, etc.
- Symptoms of allergic rections include sneezing, watery eyes, running nose and difficulty in breathing. Allergy is due to the release of chemicals like histamine and serotonin, from the mast cells.
- For determining the cause of allergy, the patient is exposed to or injected with very small doses of possible allergens, and the reactions studied.

- The use of drugs like anti-histamine, adrenalin and steroids quickly reduce the symptoms of allergy.
- Somehow, modern-day life style has resulted in lowering of immunity and more sensitivity to allergens-more and more children in metro cities of India suffer from allergies and asthma due to sensitivity to the environment. This could be because of the protected environment provided early in life.

Examples-

(i) **Bronchial Asthma :** Allergy of lower respiratory tract. It is allergy of lungs when an allergen enters inside the body by inhalation. It comes·in contact withrespiratory tube. This is characterised by the spasm of the smooth muscles present in the walls of the bronchiole. It is genera.lly caused due to the hypersensitivity of the bronchiole to the foreign substances present in the air passing through it. The mucous memebranes on the wall of the air passage start secreting excess amount of mucous, which may close the bronchi, as well as bronchiole.
Symptoms : coughing and difficulty in breathing mainly during expiration; (Wheezing)
Prevention and cure :
(a) Avoiding exposure to the foreign substance or allergens is the best preventive measure.
(b) Antibiotic therapy for removing the infection, and use of bronchodilator drugs, as well as inhalers for symptomatic relief.

(ii) **Hay Fever :** Mucosa of eyes and upper respiratory passage become hyper secretory in response to allergen mainly pollen grains.

(iii) **Anaphylactic shock :** This is generalized and most severe form of allergy. When a allergen (eg. penicillin) enter into blood, it stimulates the secretion of histamine from the mast cell of whole body, this causes vasodilation and increase permeablity of blood vessel. So large amou~t of fluid is leaked out form blood vessel into extra cellular space and decrease in blood volume cause fall in blood pressure that may lead to death.

(B) AUTO IMMUNE DISORDER

When the immune system does not discriminates between self and non-self antigen, antibodies are formed against the self antigen.
Memory-based acquired immunity evolved in higher vertebrates based on the ability to differentiate foreign organisms (e.g., pathogens) from self cells. While we still do not understand the basis of this. Two corollaries of this ability have to be understood.

(i) One, higher vertebrates can distinguish foreign molecules as well as foreign organisms. Most of the experimental immunology deals with this aspect.

(ii) Two, sometimes, due to genetic and other unkriown reasons, the bodu attacks self-cells. This results in damage to the body and is called auto-immune disease.
Rheumatoid arthritis which affects many people in our society is an auto-immune disease.

Example-

(i) **Myasthenia gravis :** In this disorder, antibodies are formed against acetylcholine receptors so these receptors are destroyed. It causes depressed nerve conduction at myoneuronal junction and decreased movements of muscles. Muscle degenerate after some time.

(ii) **Pernicious anemia :** In this disorder, antibodies are formed against Castle intrinsic factor so the vitamin B_{12} is not absorbed in intestine and blood (RBC) formation is decreased.

(iii) **Hashimoto disease :** Antibodies are formed against the thyroid gland. These antibodies destroy the thyroid gland and deficiency of thyroid hormone is called Hypothyroidism.

(iv) **Rheumatoid arthritis :** It is due to presence of rheumatoid factor (a type of immunoglobulin IgM). Its primary symptom is inflammation of synovial membrane. If it is left untreated, then the membrane thickens and synovial fluid increases, exerting pressure that causes pain. The membrane then starts secreting abnormal granules, called pannus, which after accumulating on the surface of the cartilage, cause its erosion. As a result, the fibrous tissues are attached with the bones and become ossified, making the joints immovable.
Treatment : pain and inflammation by heat treatment and physiotherapy.Joint replacement surgery is done in extreme cases.

(v) **I.D.D.M :** Insulin dependent diabetes mellitus (Type-1 Diabetes).
Antibodies are formed against the f3-cells of pancreas that cause the deficiency of insulin in body and this called I.D.D.M. Symptoms are hyperglycaemia, glycosuria, polyuria, polydipsia (excessive thirst), polyphagia (increase food intake)

(vi) **Multiple sclerosis :** Antibedies are formed against the myelin sheath of nerve cells. Destruction of myelin sheath causes neurological dysfunction.

(C) IMMUNO DEFICIENCY DISORDER

(i) **S.C.I.D. :** Severe Combined Immuno Deficiency : This disorder is due to gene mutation, involving deficiency of enzyme adenosine deaminase. This enzyme involved in maturation of T and B lymphocytes and affected individual dies at an early age.
Treatment : Gene therapy

(ii) **A.I.D.S. (Acquired immunodeficiency syndrome) :** HIV attacks on T-helper cells. This cause the decrease countof T-helper cell from normal $900 \times l0^6$ / litre to less than 200×10^6 / litre.

IMMUNOTHERAPY

Immunotherapy is a treatment procedure that involves suppression or augmentation of immune responses, to achieve therapeutic effects. Manipulation of the immune response can be carried out by modulating various components involved in it.
lmmunomodulators : These modulate the activity of a patient's immune response, either up or down, until a desired level of therapeutic effect is reached. Cytokines are natural immunomodulator secreted by one type of immune cell that elicits response in another type of immune cell, these include interleukins, interferons and tumour necrosis factors. There are two general cllr:ical approaches of im:munomodulation.

(i) **lmmunopotentiation therapies :** This includes administration of immunopotentiating agents like preformed antibodies, or interferons (a-INF in Kaposi sarcoma). This strategy augments the immune response.

(ii) **Immunosuppressive therapies :** When the patient's immune system becomes activated agqinst his or her own body, in situations such as autoimmune diseases, the response is suppressed by steroids, cyclosporine
etc. These include inhibitors of cell division, cytokine production, etc.

GENETIC DISORDERS

Autosomal ·Recessive gene mutation disorder :-

(1) **Phenyl ketonuria (PKU) :** This inborn error of metabolism is also inherited as the autosomal recessive trait. The affected individual lacks an enzyme that converts the amino acid phenylalanine into tyrosine. As. a result of this phenylalanine is accumulated and converted

into phenylpyruvic acid and other derivatives. Accumulation of these in brain results in mental retardation. These are also excreted through urine because of its poor absorption by kidney.

(2) Alkaptonuria (Black urine disease) :
This disorder is due to deficiency of enzyme homogentisic acid oxidase. Concentration of homogentisic acid increases in blood and tissue like joints, ligament, tendon, cartilage and also excreted in urine. When this urine comes in contact with air, homogentisic acid is oxidised into alkapton (Alkaptonuria) which.is black in colour so disease is also called black urine disease.

(3) Albinism : This disorder is due to deficency of enzyme tyrosinase therefore the body parts like skin, iris of eye etc., become melanin deficient. Melanin provide protection against U. V. rays.

(4) Tay-sach's disease or Infantile amourotic idiocy : This disease is first reported by Tay and Sac. This genetic disorder is due to deficiency of enzyme p-N acetyl hexosaminidase, this enzyme is involved in fat metabolism. so, the fat(conjugate lipid) accumulate in brain(ganglioside cell) and spinal cord and damage these cells. This cause mental retardation and paralysis of a normal born child and this child does not survive more than 3-4 years. There is no treatment of Tay-sach's disease. .,

(5) Thalassemia : This is also an autosome-linked recessive blood disease transmitted from parents to the offspring when both the partners are unaffected carrier for the gene (or heterozygous). The defect could be due to either mutation or, deletion which ultimately results in reduced rate of synthesis of one. of the globin hains (a and p chains) that make up haemoglobin. This causes the formation of abnormal haemoglobin molecules resulting into anaemia which is characteristic of the disease.

Thalassemia can be classified according to which chain of the haemoglobin molecule is affected. In α-Thalassemia, production of α-globin chain is affected while in β-Thalassemia, production of α-globin chain is affected. α Thalassemia is controlled by two closely linked genes HBAl and HBA2 on chromosome 16 of each parent and it is observed due to mutation or deletion of one or more of the four genes. The more genes affected, the less alpha globin molecules produced. While β Thalassemia is controlled by a single gene HBB on chromosome 11 of each parent and occurs due to mutation of one or both the genes.

Thalassemia differs from sickl.e-cell anaemia in that the former is a quantitative problem of synthe, sising too few globin molecules while the latter is a qualitative problem of synthesising an incorrectiy functioning globin.

X-Linked recessive disorders :

(1) G-6-Phosphate Dehydrogenase deficiency syndrome- G-6-P-D enzyme present in RBC. This enzyme stabilize the membrane of R.B.C. Deficiency of this enzyme cause rupture of R.B.C. when it comes incontact with sulfa drug, chloroquine, Fava bean (Favism), legumes.

(2) Duchenne's muscular dystrophy- In this disease, dystrophin protein is absent in muscles. This protein provide tensile strength to sarcolemma and prevent tearing during contraction. This protein also helps in conduction of Ca^{++} ion. Due to deficiency of dystrophin protein, muscles contraction do not occur properly.

CHROMOSOMAL DISORDERS

- The chromosomal disorders are caused due to absence or excess or abnormal arrangement of one or more chromosomes.
- Failure of segregation of chromatids during cell division cycle results in the gain or loss of a chromosome(s), called aneuploidy. For example, Down's syndrome results in the gain of extra

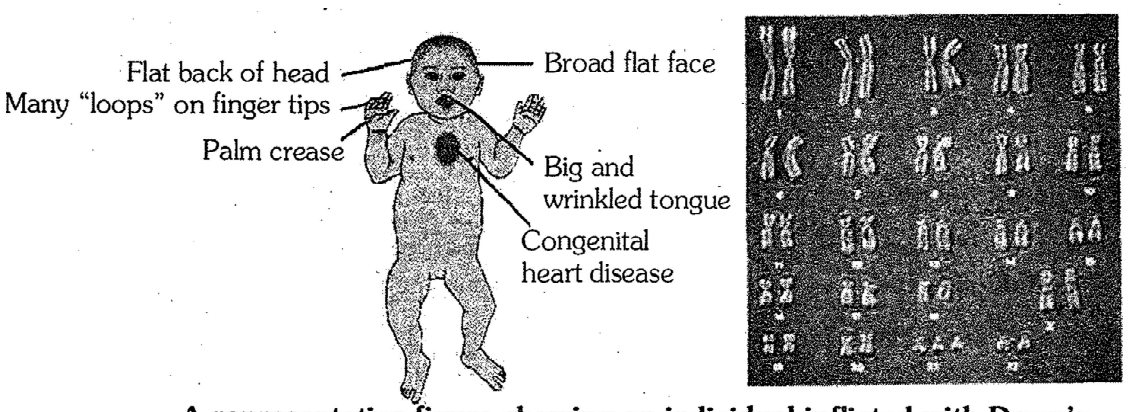
copy of chromosome 21. Similarly. Turner's syndrome results due to loss of an X chromosome in human females.

- Failure of cytokinesis after telophase stage of cell division results in an increase in a whole set of chromosomes in an organism and this phenomenon is known as polyploidy. This condition is often seen in plants.
- The total number of chromosomes in a normal human cell is 46 (23 pairs). Out of these 22 pairs are autosomes and one pair of chromosomes are sex chromosome. Sometimes, though rarely, either an additional copy of a chromosome may be included in an individual or an individual may lack one of any one pair of chromosomes. These situations are known as trisomy or monosomy of a chromosome, respectively. Such a situation leads to very serious consequences in the individual. Down's syndrome, Turner's syndrome. Klinefelter's syndrome are common examples of chromosomal disorders.

CHROMOSOMAL MUTATIONAL DISORDER

Autosomal Aneuploidy : (Change in total no. of chromosomes)

1. **Down's Syndrome :** The cause of this genetic disorder is the presence of an additional copy of the chromosome number 21 (trisomy of 21). This disorder was first described by Langdon Down (1866). The affected individual is short statured with small round head, furrowed tongue and partially open mouth. Palm is broad with characteristic palm crease. Physical, psychomotor and mental development is retarded.



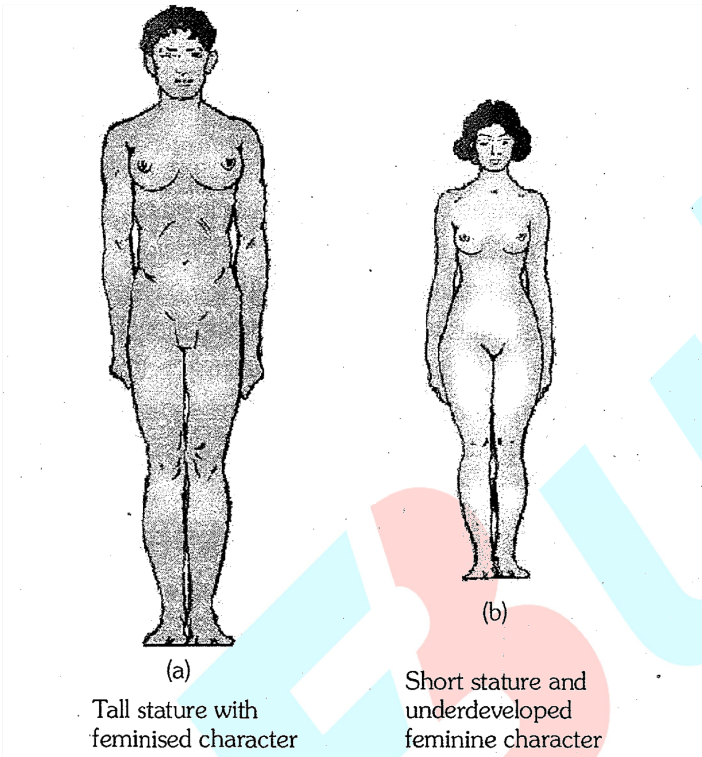
A representative figure showing an individual inflicted with Down's syndrome and the corresponding chromosomes of the individual

2	Edward syndrome	18th Trisomy
3	Patau syndrome	13th Trisomy
4	Cat cry syndrome (Cri-du-chat)	Partial deletion of short arm of 5th chromosome

Sex chromosomal Aneuploidy

1. **Klinefelter's Syndrome :** This genetic disorder is also caused due to the presence of an additional copy of X-chromosome resulting into a karyotype of 47, XXY. Such an individual has overall masculine development, however, the feminine development (development of breast, i.e., Gynaecomastia) is also expressed. Such individuals are sterile.

2. **Turner's Syndrome :** Such a disorder is caused due to the absence of one of the X chromosomes, i.e., 45 with X0, Such females are sterile as ovaries are rudimentary besides other features including lack of other secondary sexual characters.



Diagrammatic representation of genetic disorders due to sex chromosome composition in humans : (a) Klinefelter Syndrome; (b) Turner's Syndrome

3. **Super males or Jacob's Syndrome (44 + XYY)** (Incidence 1 in 1000 live born males) These patients have extra Y-chromosome. So the production of testosterone increased in these patients. These individual have abnormal height, aggressive behaviour, mentally retarded and criminal bent of mind.
4. **Super females or Multi-X females (44 + XXX)** (Incidence 1 in 1200 females) Mental retardation is proportional to the No. of X --chromosomes, sterile female.

GOLDEN KEY POINTS

- Rheumatoid factor is a type of immunoglobulin IgM .
- Anaphylaxis is a generalized and severe form of allergy .
- Hashimoto disease is also known as autoimmune thyroiditis .
- Thalassemia is an autosome linked recessive disease .
- Down's syndrome is the presence of an additional copy of the chromosome number 21 (21^{st} Trisomy)
- Turner's syndrome= 45 with XO

BEGINNER'S BOX - 3

IMMUNE SYSTEM DISORDERS AND CONGENITAL DISEASES

1. 'Pannus' is formed in which disease :-
   (1) Hashimoto disease (2) Multiple sclerosis
   (3) Rheumatoid arthritis (4) Myasthenia gravis

2. Deficiency of enzyme ADA leads to :-
   (1) AIDS (2) SCID (3) Anaphylactic shock (4) Both (1) and (2)

3. Deficiency of enzyme homogentisic acid oxidase leads to :-
   (1) Phenyl ketonuria (2) Alkaptonuria (3) Albinism (4) Polydactyly

4. 'Trisomy 18' is known as :-
   (1) Down's syndrome (2) Patau's syndrome
   (3) Edward's syndrome (4) Cat cry syndrome

5. 47 chromosomes with XXV genotype is known as :-
   (1) Turner's syndrome (2) Klinefelter's syndrome
   (3) Super male (4) Super female

COMMON DISEASES IN HUMANS

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. Most parasites are therefore pathogens as they cause harm to the host by living in (or on) them. The pathogens can enter our body by various means. multiply and interfere with normal vital activities. resulting in morphological and functional damage. Pathogens have to adapt to life within the environment of the host. For example. the pathogens that enter the gut must know a way of surviving in the stomach at low pH and resisting the various digestive enzymes

S. No.	Bacterial Diseases	Pathogen	Symptoms & Pathogenicity
1.	Typhoid fever	Salmonella typhi	• Enters small intestine through contaminated food and water and migrate to other organs through blood • Sustained high fever (39-40° C) • Weakness, constiuation, stomach uain • Headache, loss of apuetite • In severe cases intestinal perforation, death • Widal test • Mary Mallon, Nicknamed- Tyuhoid Mary (Carrier of typhoid)
2.	Pneumonia	Streptococcus pneumoniae Haemophilus influenzae	• By droplet or aerosol infection or ise of glass or utensils of infected person • Infects alveoli of the lungs • Alveoli get filled with fluid leading to severe problem in respiration • Fever with chills, cough & headache • In severe cases lips and nails turns gray to bluish in colour
3.	Dysentery (Shigellosis)	Shigella dysenteriae	• Abdominal pain • Blood & mucus in the stool • Transmits through faecal oral route
4.	Plague (Black death)	Yersinia pestis Parasite of Xenopsylla cheopis (Rat flea)	• High fever, headache • Enlargement of axillary lymph nodes
5.	Diphtheria	Corynebacterium diphtheria	• High grade fever, affects throat • Cause suffocation (Investigation:- Schick test)
6.	Tetanus (Lock jaw)	Clostridium tetani	Sustained contraction of body muscles, spasms, lock jaw, unconsciousness, opisthotonus and Risus Sardonicus - Streching of facial muscles

Note : Some other bacterial diseases-
Tuberculosis, Whooping cough (Pertussis), Cholera, Leprosy

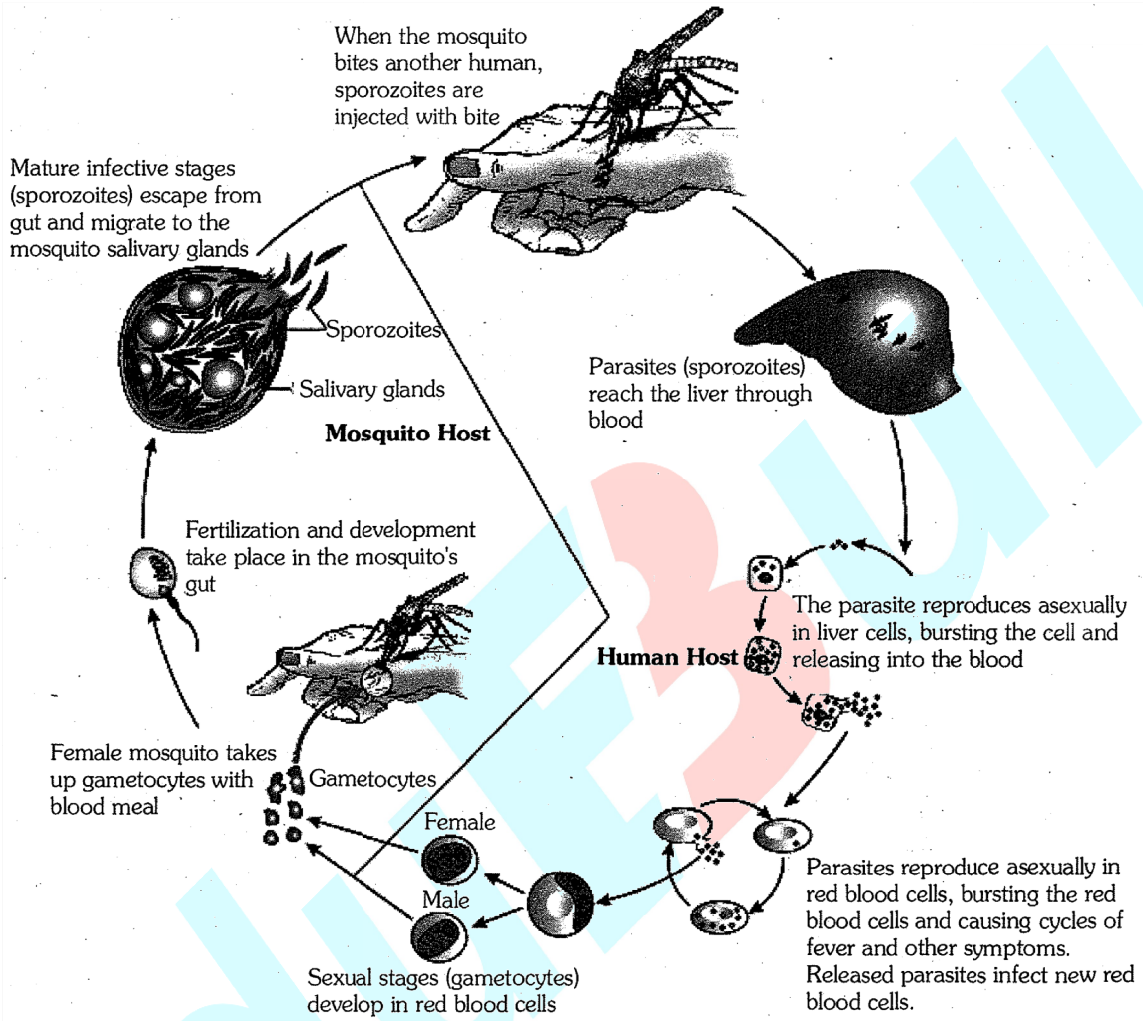
S. No.	Viral Diseases	Pathogen	Symptoms & Pathogenicity
1.	Common cold	Rhino viruses (Group of viruses)	• One of the most infectious human ailments • Transmits through droplet resulting from cough, sneez etc. • Infect nose and respiratory passage but not the lungs • Nasal congestion and discharge, sore throat, hoarseness, cough, headache, tiredness • Usually last for 3-7 days
2.	Chikun-gunya	Chikungunya virus (ss-RNA) (Vector :- Aedes-ageypti msoquito)	• Fever, joinit pain, Lymphoadenopathy
3.	Dengue fever or Break-bone-fever	Flavi-arbo virus (Vector :- Aedes-ageypti mosquito)	• Fever, severe-frontal-headache, muscle & joint pain • Bleeding from nose, mouth, hums
4.	Hepatitis-B	HBV (ds DNA)	• Severe liver damage, jaundice • Recombinant DNA-vaccine • Transmits-through parenteral and sexual-route • Can cross placenta

Note : Some other viral diseases -
Polio or poliomyelitis, Influenza, Measles, Chicken pox, Mumps, Rabies, SARS (Severe Acute Respiratory Syndrome), Swine flu

MALARIA

- Plasmodium. a tiny protozoan is responsible for Malaria. Different species of Plasmodium (P. vivax. P. malaria and P. falciparum) are responsible for different types of malaria. Of these, malignant malaria caused by Plasmodiuf!l falciparum is the most serious one and can even be fatal.
- Plasmodium enters the human body as sporozoites (infectious form) through the bite of infected female Anopheles mosquito. The parasites initially multiply within the liver cells and then attack the red blood cells ffiBCs) resulting in their rupture. The rupture of RBCs is associated with release of a toxic substance, haemozoin, which is responsible for the chill and high fever recurring every three to four days.
- When a female Anopheles mosquito bites an infected person, these parasites enter the mosquito's body and undergo further development. The parasites multiply within them to form sporozoites that are stored in their salivary glands.

- When these mosquitoes bite a human, the sporozoites are introduced into his/her body. Malarial parasite requires two hosts - human and mosquitoes -to complete its life cycle.
- The female Anopheles mosquito is the vector (transmitting agent) too.



Stages in the life cycle of *Plasmodium*

Protozoanal Disease	Pathogen	Symptoms & Pathogenicity
(1) Amoebiasis (Amoebic dysentery)	***Entamoeba histolytica***	• Parasite in large intestine • Constipation, abdominal pain and cramps • Stools with excess mucus and blood clots • Houseflies acts as mechanical carriers • Spreads through contaminated food and water

Helminthic Diseases	Pathogen	Symptoms & Pathogenicity
(1) Ascariasis	***Ascaris*** (Common Round worm)	• Intestinal parasite • Internal bleeding, muscular pain, fever, anemia, blockage of the intestinal passage • Eggs of the parasite excreted along with the faeces of infected person which contaminate soil, water, plants
(2) Elephantiasis (Filariasis)	***Wuchereria (W. bancrofti and W. malayi)*** (Filarial worm)	• Slowly developing chronic inflammation of the organs in which they live for many years **(Usually the lymphatic vessels of the lower limbs)** • Genital organs are also often affected, resulting gross deformities • Transmitted to a healthy person through the bite by the female mosquito **(**Mainly ***Culex*****)** vectors

Fungal Disease	Pathogen	Symptoms & Pathogenicity
(1) Ringworms	***Microsporum, Trichophyton & Epidermophyton***	• One of the most common infectious disease • 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, which makes them thrive in skin folds such as those in the groin or between the toes • Generally acquired from soil or by using towels, clothes or even the comb of infected individuals

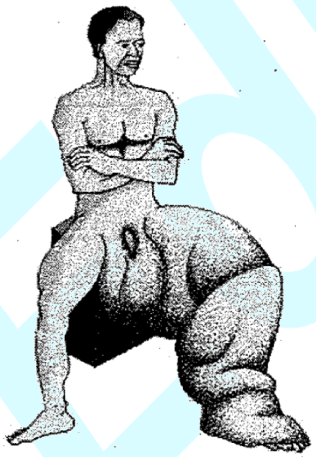


Diagram showing inflammation in one of the lower limbs due to elephantiasis

Diagram showing ringworm affected area of the skin

SEXUALLY TRANSMITTED DISEASES (STDs)

- Diseases or infection which are transmitted through sexual intercourse are collectivelu called sexually transmitted diseases (STD) or venereal diseases (VD) or reproduction tract infections (RTI).
- Gonorrhoea, syphilis, genital herpes, chlamydiasis, genital warts, trichomoniasis, hepatitis-B and of course, the most discussed infection in the recent years. HIV leading to AIDS are some of the common STDs. Among these, HIV infection is most dangerous.
- Some of these infections like hepatitis-B and HIV can also be transmitted by sharing of injection needles. surgical instruments. etc., with infected persons, transfusion of blood, or from an infected mother to the foetus too.
- Exceot for hepatitis-B, genital herpes and HIV infections, other diseases are completely curable if detected early and treated properly.
- Early symptoms of most of these are minor and include itching, fluid discharge, slight pain, swellings, etc., in the genital region.
- Infected females may often be asymptomatic and hence, may remain undetected for long. Absence or less significant symptoms in the· early stages of infection and the social stigma attached to the STDs, deter the infected persons from going for timely detection and proper treatment. This could lead to complications later, which include pelvic inflammatory diseases (PID), abortions, still births, ectopic pregnancies, infertility or even cancer of the reproductive tract.
- STDs are a major threat to a healthy society. Therefore, prevention or early detection and cure of these diseases are given prime consideration under the reproductive health-care programmes.
- Though all persons are vulnerable to these infections, their incidences are reported to be very high among persons in the age group of 15-24 years.
- Preventive measures :-
  (i) Avoid sex with unknown partners/multiple partners.
  (ii) Always use condoms during coitus.
  (iii) In case of doubt. one should go to a qualified doctor for early detection and get complete treatment if diagnosed with disease

Name of STD	Pathogen
(1) Gonorrhoea	***Neisseria gonorrhoeae*** (bacterium)
(2) Genital herpes	***Herpes simplex*** virus
(3) Genital warts	***Human papilloma*** virus
(4) Syphilis	***Treponema pallidum*** (bacterium)
(5) Trichomoniasis	***Trichomonas vaginalis*** (protozoan)
(6) Chlamydiasis	***Chlamydia trachomatis*** (bacterium)

PREVENTION AND CONTROL

- Maintenance of personal and public hygiene is very important of prevention and control of many infectious diseases.
  (i) Measures for personal hygiene include keeping the body clean: consumption of clean drinking water, food, vegetables, fruits, etc.
  (ii) Public hygiene includes proper disposal of waste and excreta; periodic cleaning and disinfection of water reservoirs, pools, cesspools and tanks and observing standard practices of hygiene in public catering. These measures are particularly essential where the infectious agents are transmitted through food and water such as typhoid, amoebiasis and ascariasis.
- In cases of air-borne diseases such as pneumonia and common cold, in addition to the above measures, close contact with the infected persons or their belongings should be avoided.
- For diseases such as malaria and filariasis that are transmitted through insect vectors, the most important measure is to control or eliminate the vectors and their breeding places. This can be achieved by avoiding stagnation of water in and around residential areas, regular cleaning of household coolers, use of mosquito nets, introducing fishes like Gambusia in ponds that feed on mosquito larvae, spraying of insecticides in ditches, drainage areas and swamps, etc.
- In addition, doors and windows should be provided with wire mesh to prevent the entry of mosquitoes, Such precautions have become all the more important especially in the light of recent widespread incidences of the vector-borne (Aedes mosquitoes) diseases like dengue and chikungunya in many parts of India.
- The advancements made in biological science have armed us to effectively deal with many infectious diseases.
- The use of vaccines and immunisation programmes have enabled us to completely eradicate a deadly disease like smallpox.
- A large number of other infectious diseases like polio, diphtheria. pneumonia and tetanus have been controlled to a large extent by the use of vaccines.
- Biotechnology is at the verge of making available newer and safer vaccines. Discovery of antibiotics and various other drugs has also enabled us to effectively treat infectious diseases.

GOLDEN KEY POINTS

- In severe cases of pneumonia, the lips and finger nails may turn gray to bluish in colour.
- Rhino virus infect the nose and respiratory passage but not the lungs.
- Malignant malaria is caused by Plasmodium falciparium.
- Heat and moisture help fungi to grow.

BEGINNER'S BOX - 4

ACQUIRED DISORDERS

1. The malignant malaria is caused by:-
   (1) P. vivax (2) P. malaria (3) P. fakiparum (4) All

2. The fungi causing ripgworm disease are :-
   (1) Microsporum (2) Trichophyton (3) Epidermophyton (4) All of the above

3. Pick wrong one out:-

(1) Elephantiasis- Wuchereria
(2) Amoebic dysentery - Entamoeba histofytica
(3) Infective stage of Plasmodium for human - Sporozoite
(4) Pneumonia- SalmoneUa typhi

4. Which of the following is a non-infectious disease?
(1) Common cold (2) Cancer (3) Malaria (4) Cholera

5. "Fluid filled alveoli" are feature of:-
(1) Amoebiasis (2) Pneumonia (3) Ascariasis (4)Typhoid

AIDS (ACQUIRED IMMUNO DEFICIENCY SYNDROME)

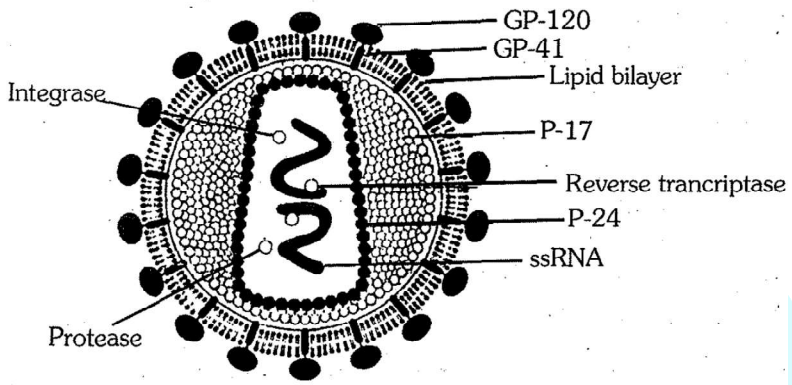
This means deficiency of immune system. acquired during the lifetime of an individual indicating that it is not a congenital disease. 'Syndrome' means a group of symptoms. AIDS was first reported in 1981 and in the last twenty-five years or so, it has spread all over the world killing more than 25 million persons.

- AIDS is a viral disease, caused by the human immunodeficiency virus (HIV), a member of group of viruses called retro virus, which have an envelope enclosing the RNA genome.
- Characerised by decrease in number of helper T-cells.
- Also called slim disease
- First detected in homosexual males in USA (1981) at Disease control centre Atlanta.
- In India first AIDS case was reported in 1986 from chennai.
- Virus was named variously
  HCLV-III =Human cell Leukemia Virus-III
  HTLV-III =Human T-lymphotrophic Virus-III
  LAV = Lymphoadenophathy associated virus
  HIV-I = Most common in India (90-120 nm) and widely distributed throughout the world.
  HIV-II = Most common in West Africa (90-120 nm)

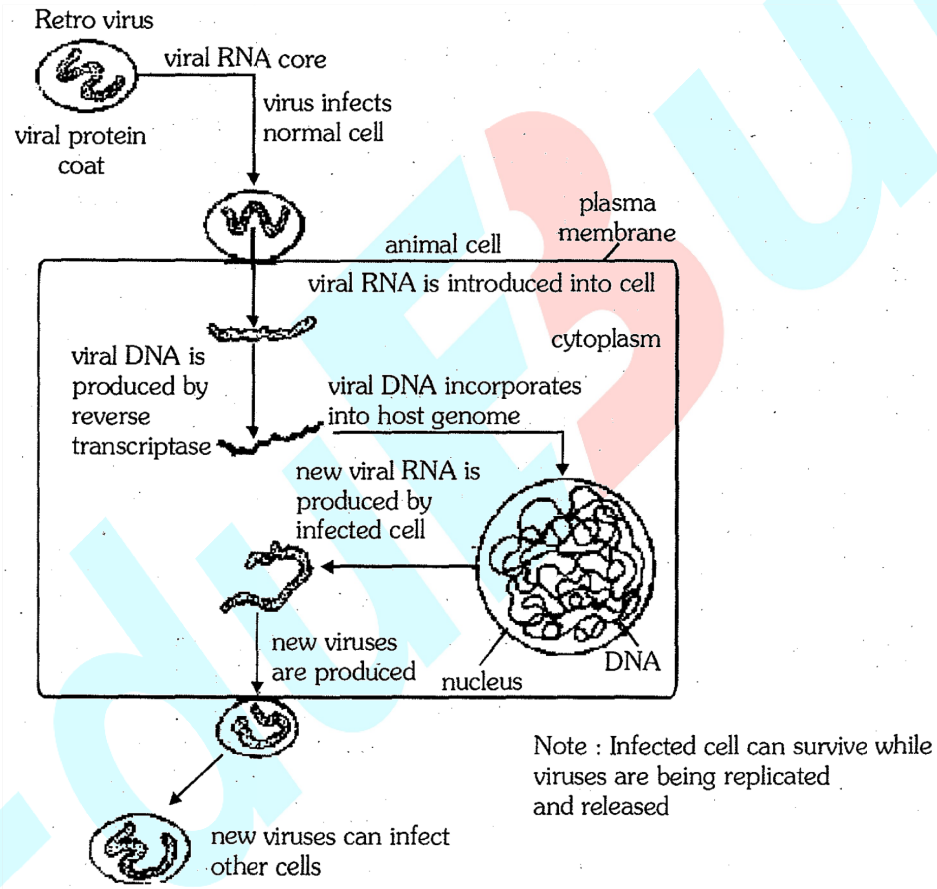
STRUCTURE & PATHOGENICITY

Structure:

- Retrovirus (Leoti virus genus and Retroviridae family)
- Core has 2 identical molecules of ssRNAs, Enzymes (reverse transcriptase, protease, Integrase)
  Core also has
  (i) Inner protein coat (P-24)
  (ii) Outer protein coat (P-17)
- Envelope is made of lipoproteins and contains GP-120 and GP-41.
- GP-120 has complementry sequence to CD-4 receptors present on Macrophages (HIV factory) and helper T-cells.



Pathogenicity :



Replication of Retro virus

- After getting 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 the enzyme reverse transcriptase. This viral DNA gets incorporated into host cell's DNA and directs the infected cells to produce virus particles. The macrophages continue to produce virus and in this way acts like a HIV factory. Simultaneously, HIV enters into helper T-lymphocytes (T H), replicates and produce progeny viruses. The progeny viruses released in the blood attack other helper T -lymphocytes.

- This is repeated leading to a progressive decrease in the number of helper T-lymphocytes in the body of the infected person. During this period, the person suffers from bouts of fever, diarrhoea and weight loss.
- Due to decrease in the number of helper T lymphocytes, the person starts suffering from infections that could have been otherwise overcome such as those due to bacteria especially Mvcobacterium, viruses, fungi and even parasites like Toxoolasma. The patient becomes so immuno-deficient that he/she is unable to protect himself/herself against these infections.

Transmission :

(i) Sexual route: due to multiple sex partners, prostitutes, homosexuality, artificial insemination.

(ii) Parenteral route: through blood contact due to unscreened blood transfusion, tattoeing, infected, poorly sterlized dental instruments.

(iii) Transplacental route = from mother to fetus =Vertical transmission, by placenta (33%)
= From mother to infants = postnatal transmission, by colostrum.

Transmission of HN-infection generally occurs by

(a) sexual contact with infected person,

(b) by transfusion of contaminated blood and blood products,

(c) by sharing infected needles as in the case of intravenous drug abusers and

(d) from infected mother to her child through placenta.

Misconceptions :

- AIDS do not spread through mere touch, physical. contact, hugging, kissing, sharing meals, shaking hands, mosquito bites, coughing, sneezing, looking after AIDS patients.

So, people who are at high risk of getting this infection includes - individuals who have multiple sexual partners, drug addicts who take drugs intravenously, individuals who require repeated blood transfusions and children born to an HIV infected mother. It is important to note that HIV I AIDS is not spread by mere touch or physical contact; it spreads only through body fluids. It is, hence, imperative, for the physical and psychological well-being, that the HIV /AIDS infected persons are not isolated from family and society.

Incubation period :- Time interval between the entry of pathogen and appearance of symptoms is called incubation period.

Window period :- Period between infection to the time when it can be laboratorically detected.

Symptoms:

- **Asymptomatic phase :** There is always a time-lag between the infection and apearance of AIDS symptoms. This period may vary from a few months to many years (usually 5-10 years). During initial 2 to 12 weeks of this period antibodies concentration is less than nanograms so ELISA test is negative this period is called as window period. Infectivity or activeness of virus is maximum in this period.
- AIDS related complex (ARC)
  * mild form of HIV
  * swollen lymph nodes, bouts of fever, repeated episodes of diarrhoea, weight loss, prolonged cough.
- Full blown AIDS

* Patient become severely immune deficient in this period. T-lymphocytes or CD_4 count < 200 x $l0^6$ / litre (normal CD_4 count > 900 × l06 / litre) and now this condition is called full blown AIDS.
* Tuberculosis by Mycobacterium avium
* Candidiasis of mouth and oesophagus by fungus Candida albicans
* Pneumonia by fungus Pneumocystis carinii
* Cancer of skin and lymphnodes (Kaposi' sarcoma)
* Encephalitis by Toxoplasma gondii (Protozoan)

Most of infections are due to opportunistic infections, appear when immunity becomes weak.

Investigations :

- **Screening test :** Enzyme linked immuno sorbent assay (ELISA).
  Confirmatory tests : Western blot test which detects antibodies, in patient's serum.

  ELISA TEST (Enzyme linked Immunosorbent Assay)
  In ELISA, Alkaline phosphatase and peroxidase enzymes are used.
  EUSA is very quick diagnostic technique for detection of a wide variety of pathogens, disorders, allergens and hormones, like -
  (i) Pregnancy test through presence of human chorionic gonadotropin (HCG) in urine or blood.
  (ii) AIDS or HN infection.
  (iii) Hepatitis.
  (iv) STD or sexually transmitted disease.
  (v) Rubella virus infection.
  (vi) Thyroid disorder etc.

Treatment:

(i) **Reverse transcriptase inhibitor** = Zidovudin (AZT), Stavudin, DDI (Didexymidine) etc.
(ii) Protease inhibitor = Ritonavir, Nelfinavir, Saquinavir etc.
(iii) Integrase inhibitor = Raltegravir, Elvitegravir etc.
(iv) HAART (Highly Active Anti Retroviral Therapy) or Cocktail treatment includes both reverse transcriptase inhibitor and protease inhibitor drugs.

- Treatment is only partially effective. only prolong the life of the patients but cannot prevent death, which is inevitable.

Prevention :

- As AIDS has no cure, prevention is the best option. Moreover, HIV infection, more often, spreads due to "conscious behaviour patterns" and is not something that happens inadvertently, like pneumonia or typhoid. Of course, infection in blood transfusion patients, new-borns (from mother) etc., may take place due to poor monitoring. The only excuse may be ignorance and it has been rightly said-" don't die of ignorance".
- In our country the National AIDS Control Organisation (NACO) and other non-governmental organisation (NGOs) are doing a lot to educate people about AIDS. WHO has started a number of programmes to prevent the spreading of HIV infection.

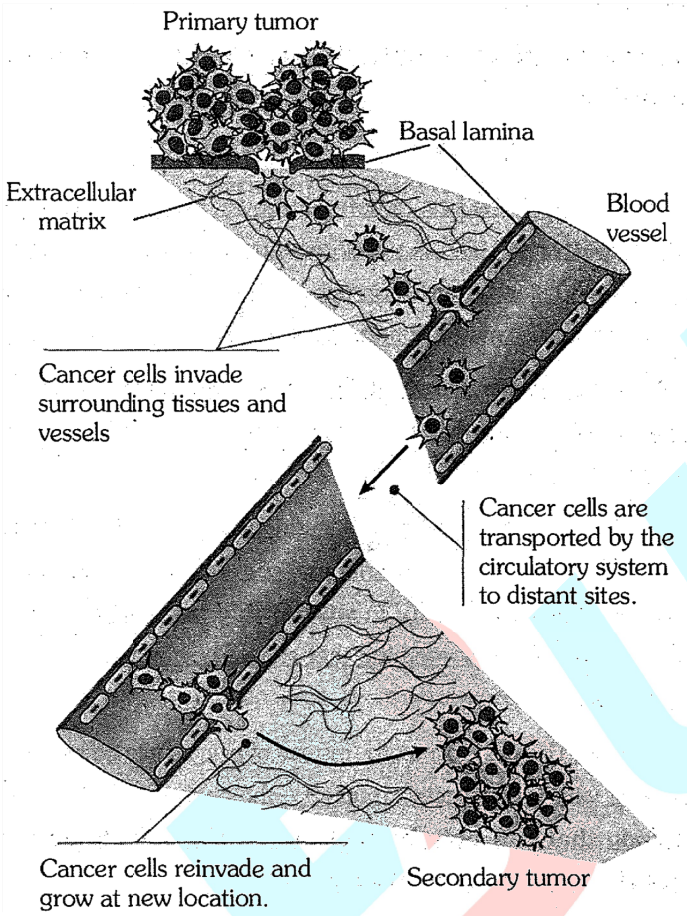
- Making blood (from blood banks) safe from HN, ensuring the use of only disposable needles and syringes in public and private hospitals and clinics, free distribution of condoms,

controlling drug abuse, advocating safe sex and promoting regular check-ups for HN in susceptible populations, are some such steps taken up.

- Infection with HN or having AIDS is something that should not be hidden - since then, the infection may spread to many more people.
- HN/AIDS-infected people need help and sympathy instead of being shunned by society. Unless society recognises it as a problem to be dealt with in a collective manner - the chances of wider spread of the disease increase manifold. It is a malady that can only be tackled, by the society and medical fraternity acting together, to prevent the spread ofthe disease.

CANCER

- Cancer is one of the most dreaded diseases of human beings and is a major cause of death all over the globe. More than a million Indians suffer from cancer arid a large number ofthem die from it annually. The mechanisms that underlie development of cancer or oncogenic transformation of cells, its treatment and control have been some of the most intense areas of research in biology and medicine.
- Uncontrolled. abnormal and excessive mitotic division of cells is called cancer (Crab= cancer). These abnormal and undifferentiated cells are called cancerous cells. Study of cancer is called oncology.
- In our body, cell growth and differentiation is highly controlled and regulated. In cancer cells, there is breakdown of these regulatory mechanisms. Normal cells show a property called contact inhibition by virtue of which contact with other cells inhibits their uncontrolled growth. Cancer cells appears to have lost his property. As a result of this, cancerous cells just continue to divide giving rise to masses of cells called tumors.
- Tumors are of two types :
  (i) Benign
  (ii) Malignant.
- Benign tumors normally remain confined to their original location and do not spread to other parts of the body and cause little damage.
- The malignant tumors, on the other hand are a mass of proliferating cells called neoplastic or tumor cells. These cells grow very rapidly, invading and damaging the surrounding normal tissues, As these cells actively divide and grow they also starve the normal cells by competing for vital nutrients. Cells sloughed from such tumors reach distant sites through blood, and wherever they get lodged in the body, they start a new tumor there. This property called metastasis is the most feared property of malignant rumors.



TYPES OF CANCER

- Cancers are classified on the basis of the tissue of origin from where they arose. Most of the cancers fall into one of the following categories :

  (i) **Carcinomas :** Cancers of this type .arise in epithelial tissues, such as skin or the epithelial lining of internal organs or glands (about 85 per cent of all tumours)

  eg. (a) Brain carcinoma (b) Oral carcinoma
  (c) Gastric carcinoma (d) Colon carcinoma
  (e) Lung carcinoma (f) Cervical carcinoma
  (g) Adeno carcinona (gland tumour) (h) Breast carcinoma

- Breast cancer in female and prostate cancer - in males are common incidence in world.
- Cervical (Uterine Cervix) cancer in females and oral cancer in males are common in India.
- Lung cancer accounts for 31.1% of all cancer death in men and 25% in women.
- Melanomas or Melanocarcinoma: These are cancerous growths of melanocytes (a type of skin cells).

  (ii) **Sarcomas:** These are derived from tissues of mesodermal origin, eg. bone, fat and cartilage. They are rare in humans (about 1 per cent of all tumours).

  eg. Bone cancer - Osteosarcoma
  Muscle cancer - Myosarcoma
  Lymph node cancer - Lymphosarcoma.

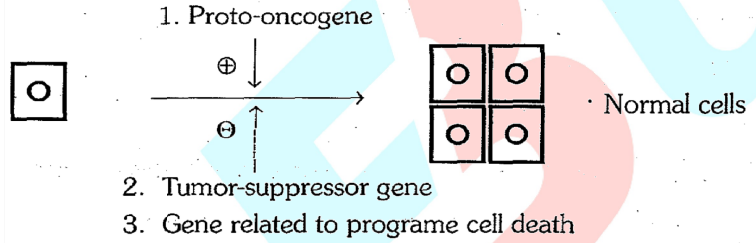
  (iii) **Leukaemias and lymphomas :** These are tumours of haematopoietic cells.

(a) **Chronic Myelogenous Leukaemia (CML):** This fatal cancer occurs mainly due to reciprocal translocation between chromosome-22 and chromosome 9 which produces abnormal chromosome 22 (Philadelphia chromosome).

(b) **Burkitt's Lymphoma :** This is produced due to reciprocal translocation between chromosomes and chromosome-14.

Normal mechanism of body growth :-

- Normal cell growth is under the control of some critical regulatory genes, which regulate cell proliferation, differentiation and survival.
- Alterations in these genes lead to oncogenic trasformation.
- These genes can be divided into the following three categories :
  (i) Genes that induce cellular proliferation, eg. genes encoding growth factors, growth factor receptors, transcription factors etc. (Proto-oncogenes). Furthermore, several genes called cellular oncogenes, (c-one) or proto oncogenes have been identified in normal cells which, when activated under certain conditions, could lead to oncogenic transformation of the cells.
  (ii) Genes that inhibit cellular proliferation **(Tumour Suppressor Genes)**.
  (iii) Genes that regulate programmed cell death. **(Suicide genes)**



- All these genes are involved in normal growth.
- Cancer is caused by mutant alleles of these genes, whose products do not respond to normal regulatory signals. As a result, the mutated cell proliferates uncontrollably.
- Cancer cells don't show contact inhibiti~n phenom~non which is shown by normal cells (when normal cells come in contact with other cells they inhibit uncontrolled growth by activation of tumour suppressor genes of cells).

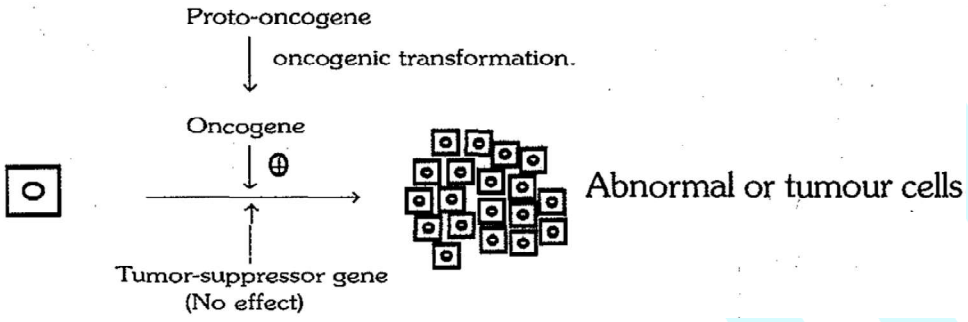
CAUSES OF CANCER

Transformation of normalcells into cancerous neoplastic cells may be induced by physical. chemical or biological agents. These agents are called carcinogens. Ionising radiations like X-rays and gamma rays and non-ionizing radiations like UV cause DNA damage leading to neoplastic transformation. The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer. Cancer causing viruses called oncogenic viruses have genes called viral oncogenes.

- Chemical or physical agents that can cause cancer are known as Carcinogens.
- Depending on their mode of action, carcinogens fall into the following main categories :
  (i) Agents that can cause alternations in the genetic material (DNA), resulting in oncogenic transformation that can lead to cancer eg. various types of radiations and chemicals.

(ii) Agents that promote the proliferation of cells, which have already undergone genetic alternations responsible for oncogenic transformation. These agents are called tumor promoters, eg. some growth factors and hormones.

(iii) Cancer causing DNA and RNA viruses. (tumour viruses) have been shown to be associated with oncogenic transformation.



CARCINOGENS

- Transformation of normal cells into cancerous neoplastic cells may be induced by physical, chemical or biological agents. These agents are-called carcinogens.

(1) **Radiations :** Ionising radiations like X-ray and gamma rays and non-ionizing radiations like UV cause DNA damage leading to neoplastic transformation: There are 5 times more incidence of leukemia in Hiroshima & Nagasaki due to radiation effect of nuclear bombing.

(2) **Chemical factor :** The chemical carcinogens present in tobacco smoke have been identified as a major cause of lung cancer. Tobacco and beta! chewing cause oral cancer. Heavy smoking (N-Nitrosodimethyl amine) causes oral cancer, cancer of larynx and lungs. Combustion product of coal and pesticides, artificial flavour, sweetners, synthetic food, add flavour, hormonal imbalance in body cause cancer.
Hormonal imbalance or estrogen excess causes breast cancer.
Urinary bladder cancer is common in dye workers.

(3) **Physical factors :** Sharp teeth cause Tongue cancer
Kashmiri people keep 'Kangri' close to skin that cause skin cancer & this skin cancer is called kangri cancer.

(4) **Biological factors :** Cancer causing viruses called oncogenic viruses have genes called viral oncogenes.

CANCER DETECTION AND DIAGNOSIS

Early detection of cancers is essential as it allows the disease to be treated successfully in many cases.
Following are the techniques for cancer detection and diagnosis

(i) **Blood examination :**

(a) This is the test for increased WBC counts in the case of leukemias.

(b) Detection of the tumor markers like - a-feto protein (AFP) for liver cancer, PSA (Prostate specific antigen) for prostate cancer, alkaline phosphatase for bone metastasis.

(ii) **Biopsy :** A piece of the suspected tissue is cut into thin sections, stained and is examined under microscope. This is generally a histopathological study by a pathologists (Cancerous cells have a very high value of karyoplasmic index, nucleus large and irregular, nucleolus large, number of mitochondria and ribosomes increase).

(iii) **F.N.A.C. :** (Fine needle aspiration cytology) - eg. breast cyst I tumour. Fluid is collected from tumors and examined for presence of cancer cells.

(iv) **Pap smear :** It is used for cervical carcinoma. Slide is prepared from cervical fluid:

(v) **X-Ray. C-T Scan arid M.R.I :** These techniques are very useful to detect cancers of the internal organs.

- In C.T. Scan. X-rays are used to generate a three dimensional image (3-D) of the internals of an object.
- In MRI we use strong magnetic fields and non-ionising radiations to accuratelydetect pathological and physiological changes in the living tissue

(vi) Modem techniques :

- Antibodies (Monoclonal) against cancer-specific antigens are also used for detection of certain cancers.
- Techniques of molecular biology can be applied to detect genes in individuals with inherited susceptibility to certain cancers. Identification of such genes, which predispose an individual to certain cancers, may be very helpful in prevention of cancers. Such individuals may be advised to avoid exposure to particular carcinogens to which they are susceptible (e.g .. tobacco smoke in case of lung cancer).

TREATMENT OF CANCER

Following are the methods :

(a) **Surgery :** By removing the entire cancerous tissue and involved lymph nodes.

(b) **Radiotherapy :** Tumour cells are irradiated lethally taking proper care of the normal cells and tissues surroundings the tumour mass. Cobalt therapy (Co- 60), Iodine therapy (1-131), X-ray radiations are given. These radiations destroy the rapidly dividing cells.

(C) **Chemotherapy :** Several chemotherapeutic drugs are used to kill the cancerous cells. Anti-cancer drugs inhibit synthesis of DNA in cancer cells stopping their cell cycle, some eg. :

- Vincristine (Weed - Cantharanthus roseus = Vinca rosea)
- Vinblastin (Weed - Cantharanthus roseus = Vinca rosea)
- Taxol - Obtained from Taxus baccata
  Majority of drugs have side effects like hair loss, anemia etc

Most of cancer are treated by combination therapy of surgery. radiation and anti cancerous drug.

(d) **Immunotherapy :**

- Monoclonal antibodies : They are designed to attach specific proteins .in cancer cells. Their uses : (i) To allow the immune system itself to destroy the cancer cells. (ii) To deliver radiation directly to cancer cells. {iii) Carry drugs directly to cancer cells.
- Cancer vaccine : Research is in progress to develop cancer vaccines.

(e) Tumor cells have been shown to avoid detection and destruction by immune system. Therefore. The patients are given substances called biological response modifiers such as a-interferon which activate their immune system and help in destroying the tumor.

GOLDEN KEY POINTS

- Capsid of HN is formed by- P_{24}, P_{17}
- Envelope of HN is formed by lipid bilayer, GP-41 & GP-120
- Carcinogen leads to oncogenic transformation.
- Cancer cells do not show contact inhibition.

BEGINNER'S BOX-5

AIDS AND CANCER

1. 'Capsid' of HN is formed by :-
(1) P-24 (2) lipoprotein (3) P-17 (4) Both (1) and (3)

2. EUSA test is used for the detection of :-
(1) HN infection (2) Hepatitis-B (3) Both (1) and (2) (4) None of these above

3. AIDS is characterized by reduction in :
(1) Mast cells (2) Neutrophils (3)RBC (4) Helper T-cells

4. Which of the following gene is absent iri a normal cell ?
(1) Proto-oncogene (2) Tumor-suppressor gene
(3) Gene related to program cell death (4) Oncogene

5. "Don't die of ignorance" is said for :-
(1) Cancer (2) AIDS (3) Malaria (4) Filaria

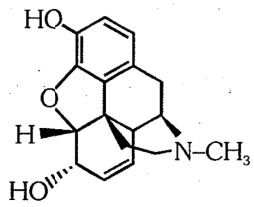
DRUGS AND ALCOHOL ABUSE

Surveys and statistics show that use of drugs and alcohol has been on the rise especially among the youth. This is really a cause of concern as it could result in many harmful effects. Proper education and guidance would enable youth to safeguard themselves against these dangerous behaviour patterns and follow healthy lifestyles. The drugs, which are commonly abused are opioids, cannabinoids and coca alkaloids. Majority of these are obtained from flowering plants. Some are obtained from fungi like LSD.
LSD (Lysergic acid diethyl amides) is a d~ngerous Hallucinogen, obtained from fruiting body of a fungus (Claviceps purpurea).

(a) Opiods : (Eg ; Morphine. Heroin, etc.)

- Opioids are the drugs, which bind to specific opioid.receptors present in. our central nervous system and gastrointestinal tract.
- Heroin commonly called smack is chemically diacetylmomhine which is a white, odourless, bitter crystalline compound. This is obtained by acetylation of morphine which is extracted from the latex of poppy plant Papaver somniferum. Generally taken by snorting and injection. heroin is a depressant and slows down body functions.

Morphine is a very effective sedative and painkiller, and is very useful in patients who have undergone surgery.

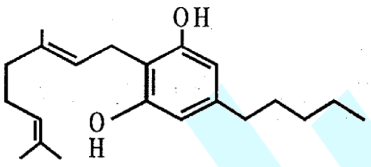


Chemical structure of Morphine

Opium poppy

(b) Cannabinoids

- These are a group of chemicals, which interact with cannabinoid receptors present principally in the brain.
- Natural cannabinoids are obtained from the inflorescences of the plant Cannabis sativa.
- The flower tops, leaves and the resin of cannabis plant are used in various combinations to produce marijuana, hashish, charas and ganja.
- Generally taken by inhalation and oral ingestion, these are known for their effects on cardiovascular system of the body.
- These days cannabinoids are also being abused by some sportspersons



Skeletal structure of cannabinoid molecule

Leaves of *Cannabis sativa*

Flowering branch of *Datura*

(C) Coca alkaloid or cocaine

- These are obtained from coca plant Erythroxylum coca, native to South America.
- It interferes with the transport of the neuro-transmitter dopamine.
- Cocaine, commonly called coke or crack is usually snorted.
- It has a potent stimulating action on central nervous system, producing a sense of euphoria and increased energy.
- Excessive dosage of cocaine causes hallucinations.

  Other well-known plants with hallucinogenic properties are Atropa bell adona and Datura.
- Drugs like barbiturates, .amphetamines, benzodiazepines and other similar drugs, that are normally used as medicines to help patients cope with mental illnesses like depression and insomnia, are often abused.
- Several plants, fruits and seeds having hallucinogenic properties have been used for hundreds of years in folkmedicine, religious ceremonies and rituals all over the globe. When these are

taken for a pumose other than medicinal use or in amounts/frequency that impairs one's physical, physiological or psychological functions, it constitutes drug abuse.

ADOLESCENCE AND DRUG/ALCOHOL ABUSE

- Adolescence means both 'a period' and 'a process' during which a child becomes mature in terms of his/her attitudes and beliefs for effective participation in society. The period between 12-18 years of age may be thought of as adolescence period.
- In other words, adolescence is a bridge linking childhood and adulthood. Adolescence is accompanied by several biological and behavioural changes. Adolescence thus is a very vulnerable phase of mental and psychological development of an individual. Curiosity need for adventure and excitement and experimentation constitute common causes. Which motivate youngsters towards drug and alcohol use.
- A child's natural curiosity motivates him/her to experiment. This is complicated further by effects that might be perceived as benefits of alcohol or drug use. Thus the first use of drugs or alcohol may be out of curiosity or experimentation but later the child starts using these to escape facing problems.
- Of late stress from pressures to excel in academics or examinations has played a significant role in persuading the youngsters to tr:y alcohol and drugs.
- The perception among youth that it is 'cool' or progressive to smoke use drugs or alcohol is also in a way a major cause for youth to start these habits.
- Television, movies, newspapers, internet also help to promote this perception. Other factors that have been seen to be associated with drug and alcohol abuse among adolescents are unstable or unsupportive family structures and peer pressure.

ADDICTION AND DEPENDENCE

- Because of the perceived benefits, drugs are frequently used repeatedly. The most important thing, which one fails to realise, is the inherent addictive nature of alcohol and drugs.
- Addiction is a psychological attachment to certain effects -such as euphoria and a temporary feeling of wellbeing - associated with drugs and alcohol. These drive people to take them even when these are not needed, or even when their use becomes self-destructive.
- 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.
- However, it should be clearly borne in mind that use of these drugs even once, can be a fore-runner to addiction.
- Thus the addictive potential, of drugs and alcohol, pull the user into a vicious circle leading to their regular use (abuse) from which he/she may not be able to get out.
- In the absence of any guidance or counselling, the person gets addicted and becomes dependent on their use.
- Dependence is the tendency of the body to manifest a characteristic and unpleasant withdrawal syndrome if regular dose of drugs/alcohol is abruptly discontinued. This is characterised by anxiety, shakiness, nausea and sweating, which may be relieved when use is resumed again. In some cases, withdrawal symptoms can be severe and even life threatening and the person may need medical supervision.
- Dependence leads the patient to ignore all social norms in order to get sufficient funds to satiate his/her needs. These result in many social adjustment problems.

EFFECTS OF DRUG/ALCOHOL ABUSE

- The immediate adverse effects of drugs and alcohol abuse are manifested in the form of reckless behaviour, vandalism and violence. Excessive doses of drugs may lead to coma and death due to respiratory failure, heart failure or cerebral hemorrhage.
- A combination of drugs or their intake along with alcohol generally results in overdosing and even deaths.
- The most common warning signs 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 behaviour, deteriorating relationships with family and friends, loss of interest in hobbies, change in sleeping and eating habits, fluctuations in weight, appetite, etc.
- There may even be some far-reaching implications of drug/alcohol abuse. If abuser is unable to get money to buy drugs/alcohol he/she may turn to stealing. The adverse effects are just not restricted to the person who is using drugs or alcohol. At times, a drug/alcohol addict becomes the cause of mental and financial distress to his/her entire family and friends.
- Those who take drugs intravenously (direct injection into the vein using a needle and syringe), are much more likely to aoguire serious infections like AIDS and hepatitis B. The viruses, which are responsible for these diseases, are transferred from one person to another by sharing of infected needles and syringes. Both AIDS and Hepatitis B infections are chronic infections and ultimately fatal. AIDS and Hepatitis B are transmitted through infected blood and both are STDs.
- The use of alcohol during adolescence may also have long-term effects. It could lead to heavy drinking in adulthood. The chronic use of drugs and alcohol damages nervous system and liver (cirrhosis). The use of drugs and alcohol during pregnancy is also known to adversely affect the foetus.
- Another misuse of drugs is what certain sportspersons do to enhance their performance. They (mis)use narcotic analgesics, anabolic steroids, diuretics and certain hormones in sports to increase muscle strength and bulk and to promote aggressiveness and as a result increase athletic performance.
- The side-effects of the use of anabolic steroids in females include masculinisation (features like males), increased aggressiveness, mood swings, depression, abnormal menstrual cycles, excessive hair growth on the face and body, enlargement of clitoris, deepening of voice.

  In males it includes acne, increased aggressiveness, mood swings, depression, reduction of size of the testicles, decreased sperm production, potential for kidney an~ liver dysfunction, breast enlargement premature baldness, enlargement of the prostate gland. These effects may be permanent with prolonged use.
- In the adolescent male or female, severe facial and body acne, and premature closure of the growth centres of the long bones may result in stunted growth.

PREVENTION AND CONTROL

- The age-old adage of 'prevention is better than cure' holds true here also.
- It is also true that habits such as smoking, taking drug or alcohol are more likely to be taken up at a young age, more during adolescence.

Hence, it is best to identify the situations that may push an adolescent towards use of drugs or alcohol, and to take remedial measures well in time. In this regard, the parents and the teachers have a special responsibility. Parenting that combines with high levels of nurturance and consistent discipline, has been associated with lowered risk of substance (alcohol/drugs/tobacco) abuse. Some of the measures mentioned here would be particularly useful for prevention and control of alcohol and drugs abuse among adolescents

(i) **Avoid undue peer pressure-** Every child has his/her own choice and personality, which should be respected and nurtured. A child should not be pushed unduly to perform beyond his/her threshold limits be it studies, sports or other activities.

(ii) **Education and counselling-** Educating and counselling him/ her to face problems and stresses, and to accept disappointments and failures as a part of life. It would also be worthwhile to channelise the child's energy into healthy pursuits like sports, reading, music, yoga and other extracurricular activities.

(iii) **Seeking help from parents and peers-** Help from parents and peers should be sought immediately so that they can guide appropriately. Help may even be sought from close and trustei:l friends. Besides getting proper advise to sort out their problems, this would help young to vent their feelings of anxiety and guilt.

(iv) **Looking for danger signs-** Alert parents and teachers need to look for and identify the danger signs discussed above. Even friends, if they find someone using drugs or alcohol, should not hesitate to bring this to the notice of parents or teacher in the best interests of the person concerned. Appropriate measures would then be required to diagnose the malady and the underlying causes. This would help in initiating proper remedial steps or treatment.

(v) **Seeking professional and medical help-** A lot of help is available in the form of highly qualified psychologists, psychiatrists, and deaddiction and rehabilitation programmes to help individuals who have unfortunately got in the quagmire of drug/alcohol abuse. With such help, the affected individual with sufficient efforts and will power, can get rid of the problem completely and lead a perfectly normal and healthy life.

SMOKING

- Smoking also paves the way to hard drugs. Tobacco has been used by human beings for more than 400 years. It is smoked, chewed or used as a snuff. Tobacco contains a large number of chemical substances including nicotine, an alkaloid. Nicotine stimulates adrenal gland to release adrenaline and nor-adrenaline into blood circulation, both of which raise blood pressure and increase heart rate. Smoking is associated with increased incidence of cancers of lungs, ut-inary bladder and throat, bronchitis, emphysema, coronary heart disease, gastric ulcer, etc. Tobacco chewing is associated with increased risk of cancer of the oral cavity.
- Smoking increases carbon, monoxide (CO) content in blood and reduces the concentration of haembound oxygen. This causes oxygen deficiency in the body.
- When one buys packets of cigarettes one cannot miss the statutory warning that is present on the packing which warns against smoking and says how itis injurious to health. Yet, smoking is very prevalent in society, both among young and old. Knowing the dangers of smoking and chewing tobacco, and its addictive nature, the ybuth and old need to avoid these habits. Any addict requires counselling and medical help to get rid of the habit.

Diseases and disorders of smoking

(1) **Lung** cancer

(2) **Bronchitis-** Inflammation of bronchi

(3) **Emphysema-** It is a chronic disorder in which alveolar walls are damanged dtie to which respiratory surface is decreased.

(4) **Heart disease-** Lumen of blood vessels become narrow which increases the blood pressure(Hypertension)

(5) Intestinal ulcer and other irregularities of Gut.

ALCOHOL AND ALCOHOLISM

- Ethyl alcohol is consumed as fermented beverages with low content of alcohol(beer, wine) and as distilled beverages with a relatively high alcohol percentage (Brandy, Rum, Whisky, Gin).
- This alcohol is rapidly absorbed from the wall of stomach and enters the blood stream within minutes of ingestion.
- In the llver alcohol is converted into a more toxic substance acetaldehyde.

Effects of alcohol drinking -

(1) Lowering of blood sugar level (Hypoglycemia).

(2) Alcohol drinking affects the cerebellum part of brain so control and coordination of the body affected.

(3) **Effects on liver -** The liver is the organ most affected by alcohol.
Excess alcohol in the blood causes increase in the synthesis of fat which is deposited in the liver cell and bile ducts. This results in the "Fatty liver syndrome"
The further stages of this are "Liver cirrhosis" and "Billiary cirrhosis diseases". Liver become fibrous.

(4) **Amnesia -** Loss of memory

(5) **Gastritis -** It causes the inflammation in the wall of stomach. In chronic cases the gastric ulcers usually develop.

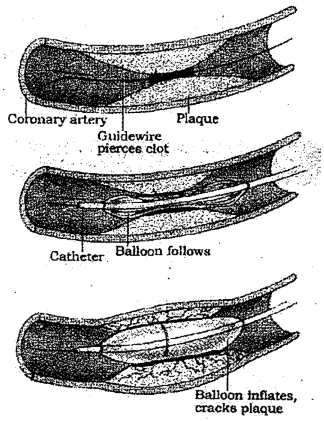
(6) **Resistance of the body -** Body resistance against disease is reduced.

(7) **Alcohol psychosis (madness)**

BIOMEDICAL TECHNOLOGIES

Coronary Artery Bypass Grafting (CABG) :

It is a way of increasing the blood supply to the heart. In this surgical procedure, a blood vessel from another part of the body is used to bypass the blocked region of a coronary artery. The two vessels used most often are the saphenous vein from the leg, and theintemal mammary artery from the chest.



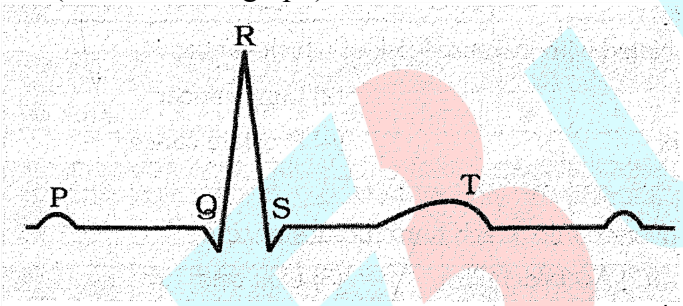
Balloon catheterisation

P.T.C.A. (Percutaneous transluminal coronary angioplasty):

It is a technique for unblocking coronary arteries that have atherosclerotic plaque. A balloon catheter is inserted into an artery of the arm or thigh and gently guided through the arterial system under X-ray observation artery. Then, while dye is, being released, angiograms are taken to localise the plaques. Next, the catheter is advanced to the point of obstruction and a balloon-like device is inflated with air to squash the plaques against the blood vessel wall, there by clearing the channel for the blood even in cases where it had previously been partially blocked.

ELECTROCARDIOGRAPH (ECG)

You are probably familiar with this scene from a typical hospital television show: A patient is hooked up to a monitoring machine that shows voltage traces on a screen and makes the sourid "... pip... pip... pip .... peeeeeeeeeeeeeeeeeeeee" as the patient goes into cardiac arrest. This type of machine (electro-cardiograph) is used to obtain an electrocardiogram (ECG).



Diagrammatic presentation of a standard ECG

- ECG is a graphical representation of the electrical activity of the heart during a cardiac cycle. To obtain a standard ECG, a patient is connected to the machine with three electrical leads (one to each wrist arid to the left ankle) that continuously monitor the heart activity. For a detailed evaluation of the heart's function, multiple leads are attached to the chest region.
- Each peak in the ECG is identified with a letter from P to T that corresponds to a specific electrical activity of the heart.
- The P-wave represents the electrical excitation (or depolarisation) of the atria, which leads to the contraction of both the atria.
- The QRS complex represents the depolarisation of the ventricles, which initiates the ventricular contraction. The contraction starts shortly after 0 and marks the beginning of the systole.
- The T-wave represents the return of the ventricles from excited to normal state (repolarisation). The end of the T-wave marks the end of systole.
- Obviously, by counting the number of QRS complexes that occur in a given time period, one can determine the heart beat rate of an individual. Since the ECGs obtained from different individuals have roughly the same shape for a given lead configuration, any deviation from this shape indicates a possible abnormality or disease. Hence, it is of a great clinical significance.

GOLDEN KEY POINTS

- Opium is derived from latex of unripe fruits of Papaver somniferum.
- Heroin is chemically diacetylmorphine, white, odourless, bitter & crystalline compound.
- Nicotine causes stimulation of nerve impulse and muscle relaxation.

- PTCA is also known as balloon catheterization.
- Penicillin is a bacteriocidal drug which inhibits cell wall synthesis of bacteria.

BEGINNER'S BOX - 6

DRUGS AND ALCOHOL ABUSE

1. Which of the following is included in cannabinoid ?
(1) Morphine (2) Heroin (3) Codeine (4) Charas

2. Receptors of opioids are present in:-
(1) CNS (2) GIT (3) Both (1) and (2) (4) Spleen

3. Depolarization of atria is represented by which wave:-
(1) T -wave (2) Q-wave (3) QRS complex (4) P-wave

4. Which of the following is bacteriostatic drug ?
(1) Streptomycin (2) Chloramphenicol (3) Ampicillin (4) Penicillin

5. Tabacco chewing is associated with increased risk of which cancer:-
(1) Oral cancer (2) Lung cancer
(3) Urinary bladder cancer (4) Prostate cancer

6. In the liver, alcohol is converted into which harmful substance ?
(1) Formaldhehyde (2) Acetaldehyde (3) Uric acid (4) No change

POINTS TO REMEMBER

CHEMOTHERAPY : Treatment with chemicals (Medicine)

(A) **Antibiotics :** Substances which are secreted by microorganism that inhibit the growth or destroy the other microorganism are called antibiotics. This term was given by Walksman (Streptomycin-first bacterial antibiotic obtained from bacteria- Streptomycin griseus).
Example - Bacteriostatic-Tetracycline, Chloramphenicol,
Bacteriolytic or Bacteriocidal-Streptomycin, Ciprofloxacin, Ampicillin.

(B) **Analgesics :** Substance that relieves pain.
Example - Opioid analgesics - Morphine, Codeine,
Others - Diclofenac

(C) **Antipyretics (Antifebrile) :** (Pyrexia- Fever) Substance that reduces temperature or fever of body.
Example - Aspirin (Acetyl salicylic acid)- (It produces gastric ulcer so not extensively recommanded as a analgesic), Ibuprofen, Paracetamol, Nimesulide.

(D) **Antihistaminic drug:** These drugs give relief from allergies by neutralizing histamine that is released from the ruptured mast cell. e.g. Cetirizine

ANSWER KEY

BEGINNER'S BOX-1

1.	(4)	**2.**	(2)	**3.**	(1)	**4.**	(4)	**5.**	(4)

BEGINNER'S BOX-2

1.	(3)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(4)

BEGINNER'S BOX-3

1.	(3)	**2.**	(2)	**3.**	(2)	**4.**	(3)	**5.**	(2)

BEGINNER'S BOX-4

1.	(3)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(2)

BEGINNER'S BOX-5

1.	(4)	**2.**	(3)	**3.**	(4)	**4.**	(4)	**5.**	(2)

BEGINNER'S BOX-6

1.	(4)	**2.**	(3)	**3.**	(4)	**4.**	(2)	**5.**	(1)	**6.**	(2)