# INFLAMMATION

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- **Definition:**
- Inflammation (Latin, *inflammatio*, to set on fire) is the complex biological response of vascular tissues to harmful stimuli, such as pathogens, damaged cells, or irritants.
- It is a protective attempt by the organism to remove the injurious stimuli as well as initiate the healing process for the tissue.
- Inflammation is designated by adding the suffix “itis” to the English, Latin or Greek name of the organ affected e.g tonsillitis, appendicitis, gastritis …etc.

- Inflammation is not a synonym for infection. Even in cases where inflammation is caused by infection it is incorrect to use the terms as synonyms.
- infection is caused by an exogenous pathogen, while inflammation is the response of the organism to the pathogen.
- In the absence of inflammation, wounds and infections would never heal and progressive destruction of the tissue would compromise the survival of the organism.
- However, inflammation which runs unchecked can also lead to severe progressive diseases such as rheumatoid arthritis.

- **Causes:**
- Infection by pathogens
- Physical injury, blunt or penetrating
- Chemical irritants
- Burns
- Ionizing radiation
- Foreign bodies
- Frostbite
- Toxins
- Necrosis
- Immune reactions due to hypersensitivity

- **Types:**

1. **Acute inflammation:** Caused by an irritant of short duration of action.
- The tissue response is rapid and is of sudden onset.
- Inflammation lasts for days to weeks and is characterized by the presence of fluid exudate, fibrin threads and polymorphonuclear leucocytes (PML).

2. **Chronic inflammation:** caused by an irritant of long duration of action.
- The tissue response is slow and is of gradual onset.
- Inflammation lasts for months to years.
- It is characterized by the presence of macrophages, plasma cells, lymphocytes and fibrosis.

3. **Subacute Inflammation:** Grades between the acute and the chronic types.

# ACUTE INFLAMMATION

- Acute inflammation is a short-term process which is characterized by the classic signs of inflammation - swelling, redness, pain, heat, and loss of function - due to the infiltration of the tissues by plasma and leukocytes.
- It occurs as long as the injurious stimulus is present and ceases once the stimulus has been removed, broken down, or walled off by scarring (fibrosis).

- The acute inflammatory reaction consists of:

- Local tissue damage.
- Local vascular reactions.
- Local reaction of tissue histiocytes.

# I.LOCAL TISSUE DAMAGE

- Occurs at the center of the inflamed area as the irritant is at maximum action.
- The central cells are killed i.e. necrosis.
- The surrounding cells are less severely injured i.e. degeneration.
- This local damage of cells together with the inflammatory stimulus trigger the release and activation of chemical substances called chemical mediators as histamine serotonin, prostaglandins and others.
- These chemical mediators play an important role in promoting the vascular and cellular changes in the inflamed area.

# II.LOCAL VASCULAR REACTIONS

- This include:

1. **Transient constriction of the blood vessels:**

- Caused by a direct stimulating action of the irritant on the vascular wall.
- It is a protective mechanism that lasts for seconds to minutes

2. **Dilatation of the blood vessels:** Occurs in the arterioles, capillaries and venules due to:

❖ Direct action of histamine on the vascular wall.

❖ Local axon reflex.

- The dilatation of the arterioles and capillaries with increase in the blood flow is called hyperemia.
- The inflamed area becomes red and hot.

**3. Slowing of the blood stream (stasis):**

- ❖ The main cause of stasis is increased viscosity of the blood due to formation of the inflammatory fluid exudate.
- ❖ Histamine causes swelling of the vascular endothelium which become sticky and offer mechanical resistance to the blood flow.
- Swelling of the vascular endothelium cause widening of the inter-endothelial spaces and increases vascular permeability.
- ❖ Most of the capillaries in the inflamed area open and the blood reaching the arterioles will be distributed among a large number of capillaries, so slowing occurs.
- Stasis in the vessels may lead to thrombosis.
- Thrombosis cuts the blood supply and more necrosis occurs in the inflamed area.

## 4. Formation of the inflammatory exudate:

- The intravascular contents (plasma and cells ) escape into the interstitial tissue space forming the inflammatory exudate.
- This consists of a fluid component and a cellular component.

# The Inflammatory fluid exudate

- **Formation:**

1. The inflammatory fluid exudate leaves the dilated capillaries and venules due to:
2. The main cause is increased vascular permeability to plasma and its proteins caused by histamine and Kinins. This is helped by endothelial damage occurring in severe inflammation.
3. Increased capillary hydrostatic pressure due to dilatation of the arterioles and increased blood flow. This pushes fluids outside the capillaries.

3. Increased osmotic pressure of the interstitial tissue fluid as the large protein molecules split into smaller ones in the process of tissue necrosis. This acts as suction force from the capillaries.
4. In acute inflammation the tissue ground substance becomes more fluid in structure due to de-polymerization of its mucopolysaccharides. This allows easy accumulation of the fluid exudate.

- **Amount:**
- depends upon:

1. The structure of the inflamed tissue, so scanty in solid tissues as bone and excess in soft tissues and serous sacs.
2. Nature of the irritant e.g excess in burns and allergic inflammation.
3. Lymphatic obstruction by inflammation and fibrin thrombi delays drainage of the exudate and leads to its accumulation.

- **Composition:**

1. High protein content, 4-8 gm% (the normal interstitial tissue fluid contains 1gm% protein).
2. The fibrinogen is specially increased.
3. The specific gravity is above 1018.
4. It is turbid and clots on standing.

- **Function:**

1. It dilutes toxins, chemicals and poisons, so minimizes their effects.
2. Brings antibodies from the blood to the site of inflammation.
3. Supplies nutrition for the cells and carries away waste products.
4. Supplies fibrinogen which changes to fibrin.

- Fibrin has the following functions:

a. Forms a network upon which PNL and macrophages move towards the irritant.
b. Localizes infection by surrounding the inflamed area and blocking the interstitial tissue spaces and some lymphatic vessels.
c. Forms a network upon which fibroblasts proliferate and start repair.

- **Fate:**
- The inflammatory fluid exudate cannot be drained by the venules because of its high osmotic pressure.
- It is drained by the dilated lymphatics.
- The drained exudate may carry bacteria and their toxins to the draining lymph nodes causing acute lymphadenitis.
- The nodes become enlarged and soft.
- Microscopically PML and macrophages appear in its sinuses and the Littoral cells show active phagocytosis.
- The exudate may carry bacteria and their toxins to the blood stream causing toxemia, bacteremia or septicemia.

# The inflammatory cellular exudate

- **Leucocyte Activation:** takes place by binding of specific chemical mediators to specific receptors on the surface of leucocytes. Leucocyte activation is characterized by:

a. Activation of adhesion molecules on the surface of the leucocytes
b. Activation of intracellular contractile protein filaments, actin and myosin which are responsible for cellular movements
c. Production of chemical mediators as arachidonic acid metabolites.
d. Activation of phagocytic activity by binding to opsonin, degranulation and secretion of enzymes, and oxidative burst mechanisms.

# Cellular exudate formation

- Cellular exudate formation occurs along the following steps:

1. **Margination (pavementing) of leucocytes:** the PML leave the axial blood stream due to stasis and settle on the sticky endothelial lining of the capillaries.
2. **Emigration of leucocytes:** the PML push their way between the swollen endothelial cell though the widened inter-endothelial spaces by means of pseudopodia and pass outside the vessels by amoeboid movement.

3. **Emigration of monocytes:** occur in the same way as PML. The monocytes and tissue histiocytes in the inflamed area change to macrophages.
4. **Diapedesis of red cells:** is the mechanical pushing of the red cells which have a small diameter by the intra-vascular hydrostatic pressure through the widened inter- endothelial spaces. The role of red cells in acute inflammation is unknown.

5. **Chemotaxis:** is the directed movement of the PML and macrophages in the area of inflammation towards the irritant.

- Chemical products of neutrophils as leukotrienes, lysosomes, complement system (C3a, C5a) and lympokines from activated lymphocytes have a role in the process of chemotaxis.
- They form a chemical gradient of chemokines (chemotaxis agents) which direct the inflammatory cell movement on the fibrin threads.
- Cocci exert a chemotactic effect mainly on PML, typhoid bacilli have a chemotactic effect on monocytes while dead cells and hemosiderin have a chemotactic effect on macrophages.

6. **Phagocytosis:** is the ingestion and destruction of bacteria, necrotic debris and foreign particles by the phagocytic cells.

- Phagocytosis in acute inflammation carried by:

**A. Microphages:** these are the PML. They surround the bacteria by pseudopodia and engulf them inside vacuoles (phagosomes) in their cytoplasm where they are acted upon and destroyed by the lysosomal digestive enzymes.

- The process of phagocytosis is greatly facilitated by plasma factors called opsonins which coat the bacterial surfaces.
- Opsonins include antibodies and components of complement system.

- Strong bacteria produce powerful toxins (leucocidins) which destroy the PML.
- Dead polymorphs release lysosomal enzymes witch digest the necrotic tissue helping pus formation and repair process.
- The dead polymorphs are called “pus cells”.
- Oxygen free radicals O2, OH and H2O2 generated from the oxidative burst are lethal to bacteria. This is called bacterial killing by oxygen dependent mechanism.

**B. Macrophages:** derived from blood monocytes and tissue histiocytes.

- They play a minor role in phagocytois and killing of bacteria, dead cells, necrotic debris and fibrin threads.
- The efficiency of phagocytosis is influenced by virulence of bacteria, presence of opsonins and nature of inflamed tissue.
- Phagocytosis is less efficient in loose tissues and serous sacs.

# III. LOCAL REACTION OF TISSUE HISTIOCYTES

- Late in acute inflammation the macrophages replace the PML.
- Macrophages are derived from tissue histiocytes and blood monocytes.
- They have a longer life span than the PML.
- They phagocytose dead bacteria, necrotic debris, pus cells and fibrin threads cleaning the area of inflammation and preparing the tissue for the repair.
- Cells of the reticulo-endothelial system and microglia perform the same function.

# CHEMICAL MEDIATORS OF ACUTE INFLAMMATION

- Chemical mediators are factors derived from plasma and cells (neutrophils, monocytes, macrophages, mast cells, endothelium, smooth muscles, fibroblasts and platelets).
- They are found as precursors in inactive forms.
- The inflammatory stimulus triggers their release, activation, or *de novo* synthesis.
- The chemical mediators act by binding to specific receptors on the target cells.

1. ***Cellular factors:***

***a. Vaso active amines:*** As histamine and serotonin released from mast cells and platelets.

**b. Arachidonic acid (AA) metabolites:**

- Prostaglandins: released from most types of cells.
- Leukotrienes: produced by PML.

**c. Lysosomal components:** Released from PML, macrophages and platelets.

**d. Cytokines:** Lymphokines derived from activated lymphocytes and monokines from activated mononuclear phagocytes.

2. **Plasma factors:**

a. **Kinin system: e.g:** bradykinin, kininogen, and kallikrein.

b. **Complement components:** specially C3a and C5a.

c. **Coagulation system:** Changes fibrinogen to fibrin

d. **Fibrinolytic system:** Dissolves fibrin.

- **The main actions of chemical mediators are:**
  1. **Vascular dilatation:** caused by histamine, prostaglandins, C3a and C5a.
  2. **Increased vascular permeability:** caused by histamine, kinins, leukotrienes, and prostaglandins.
  3. **Chemotaxis:** caused by leukotrienes and lysosomal enzymes.

# GENERAL CHANGES IN ACUTE INFLAMMATION

## 1. Leucocytosis:

- An increase number of PML in the blood above l0000/$mm^3$ (4000-10000/$mm^3$).
- Leucocytosis is caused by adenine compounds released from the nucleoprotein of the necrotic tissue called "leucocytosis promoting factor".
- It is released in the blood stream and causes a leucoblasric reaction in the bone marrow.

## 2. Fever (pyrexia):

- Pyrogenic substances (fever producing) are released from the bacteria and dead leucocytes.
- Pyrogenic substances disturb the function of the heat regulating centre in the hypothalamus causing fever.
- Fever disturbs the vitality of bacteria, but is also harmful to the tissues of the body.

# CARDINAL SIGNS AND SYMPTOMS OF ACUTE INFLAMMATION

1. **Redness:** caused by vascular dilatation and opening of all collapsed capillaries.
2. **Holness:** caused by arteriolar dilatation and increased blood flow.
3. **Swelling:** caused by the vascular dilatation and accumulation of inflammatory fluid and cellular exudate.
4. **Pain:** caused by: (a) irritation of the nerve endings by chemical mediators (b) pressure of the inflammatory exudate on the sensory nerves.
5. **Loss of function:** due to: (a) pain (b) tissue damage

# COURSE OF ACUTE INFLAMMATION

1. **Resolution:**

- The complete restoration of the inflamed tissue back to a normal status.
- Inflammatory measures such as vasodilation, chemical production, and leukocyte infiltration cease.
- Damaged parenchymal cells regenerate.
- In situations where limited or short lived inflammation has occurred this is usually the outcome.

## 2. Fibrosis:

- Large amounts of tissue destruction, or damage in tissues can not be regenerated completely by the body.
- Fibrous scarring occurs in these areas of damage.
- A scar is composed primarily of collagen.
- The scar will not contain any specialized structures, such as parenchymal cells, hence functional impairment may occur.

3. **Abscess Formation:**

- A cavity is formed containing pus, an opaque liquid containing dead PML and bacteria with debris from destroyed cells.

4. **Progression and spread:**

- The bacteria overcome the defense mechanism and inflammation spreads directly, by lymphatics, and by blood causing fatal septicemia.

**5. Chronicity:**

- If the injurious agent persists then acute inflammation will change to chronic inflammation.
- This process lasting many days, months or even years, may lead to the formation of a chronic wound.
- Chronic inflammation is characterized by the dominating presence of macrophages in the injured tissue.
- These cells are powerful defensive agents of the body, but the toxins they release (including reactive oxygen species) are injurious to the organism's own tissues as well as invading agents.
- Consequently, chronic inflammation is almost always accompanied by tissue destruction.

# TYPES OF ACUTE INFLAMMATIONS

**I. Suppurative inflammation:** includes:

**1. Localized inflammation:**

a) abscess

b) furuncle

c) Carbuncle

**2. Diffuse inflammation:**

a) Cellulitis

II. **Non suppurative inflammation:** includes:

(1) Catarrhal inflammation.

(2) Membranous inflammation.

(3) Sero-fibrinous inflammation.

(4) Fibrinous inflammation.

(5) Serous inflammation.

(6) Haemorrhagic inflammation.

(7) Necrotizing inflammation.

(8) Allergic inflammation.

# I. SUPPURATIVE INFLAMMATION (Pyogenic or Septic)

- ***Definition***:
- Severe acute inflammation characterized by pus formation.
- ***Cause***:
- Pyogenic microorganisms as staphyloccocus aureus, streptococcus hemolyticus, pneumococcus, gonococcus and bacillus coli.

# PUS

- **Pathogenesis of pus formation:**
- Pyogenic microorganisms cause marked tissue necrosis by its toxins.
- They exert strong chemotaxis on PML.
- Many PML are killed during their struggle with the bacteria and are called pus cells.
- The dead leucocytes release proteolytic enzymes which cause rapid liquefaction of the necrotic tissue and the fibrin threads.
- The resulting fluid material mix with the other products of the inflammatory process (fluid and cellular exudate) forming the pus.

- **Composition of pus:**

1. Bacteria living and dead and their toxins.
2. Liquefied necrotic tissue mainly peptones.
3. Inflammatory cellular exudate in the form of PML, many pus cells, macrophages and red cells.
4. Inflammatory fluid exudate.

- **Characters of pus of staphylococcal aureus infection:**

1. Thick, turbid, yellow, odorless, alkaline fluid.

- The thick consistency is due to the high content of nucleic acid.

2. The yellow color is due to the presence of:

❖ Many pus cells

❖ Yellow pigments produced by staphylococcus aureus

❖ The brown hemosiderin granules

3. Pus does not clot on standing because its fibrinogen content is destroyed by the proteolytic enzymes.

# Suppurative inflammation

# Abscess

- **Definition:**
- A localized suppurative inflammation resulting in the formation of an irregular cavity containing pus.
- It is a defensive reaction of the tissue to prevent the spread of infectious materials to other parts of the body.

- **Cause:**
- An abscess formed by the tissue on the basis of an infectious process (usually caused by bacteria commonly staphylococcus aureus or parasites) or other foreign materials (e.g. splinters, bullet wounds, or injecting needles).
- **Site:**
- Commonly the abscess occurs in the subcutaneous tissue, but it may occur in any organ as the lung, brain, liver …… etc.

- **Pathology of an abscess:**

1. Early the abscess shows two zones, a central necrotic zone surrounded by a zone of acute inflammation containing large number of PML.
2. Many PML die and their liberated proteolytic enzymes liquefy the margin of the necrotic area with the formation of pus, so the abscess shows three zones.

(a) Central necrotic core which gradually diminishes in size by liquefaction of its margin until it disappears.

(b) Midzone containing pus, the abscess cavity usually formed by hours.

(c) Peripheral zone of inflamed tissue called pyogenic membrane.

3. The abscess enlarges by further necrosis and liquefaction of the surrounding inflamed zone until the staphylococci produce the coagulase enzyme which helps fibrin formation that localizes the inflammation.
4. A subcutaneous abscess appears as a localized tender swelling covered by red edematous skin with opaque yellow centre.

- The covering epidermis may undergo necrosis and the pus escapes.
- When the abscess cannot evacuate itself spontaneously, surgical incision is needed as the body can absorb pus only very slowly.
- An internal abscess as in the lung, liver or spleen opens in a hollow organ as in the bronchi, intestine ... etc.

5. Once pus is evacuated healing by granulation tissue occurs.

- **Complications:**

1. Lymphatic spread of infection causes lymphangitis and lymphadenitis.
2. Blood spread of bacteria and its toxins causes bacteremia, septicemia or toxemia.
3. Septic thrombophlebitis causes pyemia.
4. Inadequate drainage and treatment changes the abscess to a chronic ore. A chronic abscess has a thick fibrous wall.
5. Complications of healing in the form of chronic ulcer, sinus, fistula and keloid.

# Furuncle (boil)

- **Definition:**
- A localized suppuration inflammation formed of small abscess related to a hair follicle or sebaceous gland.
- It is caused by staphylococcus aureus.
- Common sites are face and back of the neck in males and axilla in females.
- Multiple furuncles are called furunculosis.

# Carbuncle

- **Definition:**
- A type of localized suppuration forming multiple communicating suppurative foci in the skin and subcutaneous fat discharging pus through several openings.
- **Cause:** Staphylococcus aureus.
- Diabetes mellitus is a common predisposing factor.

- **Sites:**
- Areas where the skin and subcutaneous tissue are thick and tough as the back of the neck, scalp and buttocks.
- **Pathology:**
- Multiple communicating suppurative foci in the subcutaneous fat opening on the surface at multiple points particularly at the base of the hair follicles.

- Each suppurative focus develop in the same way as an abscess.
- The development of multiple suppurative foci in carbuncle is due to the presence of dense fibrous septa extending from the deep fascia up to the dermis dividing the area into several compartments.

# Cellulitis (Phlegmonous inflammation)

- **Definition:**
- Acute diffuse suppurative inflammation.
- **Cause:**
- Streptococcus hemolylicus.
- The organism produces two enzymes:

(1) Fibrinolysin (streptokinase): Dissolves fibrin.

(2) Hyaluronidase (spreading factor): Dissolves hyaluronic acid of ground substance helping spread of bacteria and its toxins.

- **Sites:**
- Loose connective tissue as subcutaneous tissue, fascial planes, areolar tissue of the orbit, pelvis, scrotum and wall of the appendix.
- **Pathology:**
- The basic pathological changes are similar to those of abscess with the following differences:

(1) Failure of localization because of absence of fibrin.

(2) The necrosis is extensive and the separated dead masses are called roughs.

(3) Pus formation is slow.

- Pus is thin in consistency and may contain many red cells i.e. sanguinous.

- **Complications**:

(1) Acute lymphangitis and lymphadenitis.

(2) Septic thrombophlebitis causing pyemia.

(3) Septicemia.

# NON-SUPPURATIVE INFLAMMATION

# Catarrhal inflammation

- **Definition:**
- Mild acute non suppurative inflammation of the mucous membranes characterized by excess mucus secretion e.g. catarrhal rhinitis, bronchitis, appendicitis ... etc.

- **Gross Picture:**
- Early the mucous membrane appears red, hot, swollen and dry.
- Dryness is due to temporary cessation of mucus secretion.
- Then excess watery mucoid discharge appears, composed of inflammatory fluid exudate, mucus, small number of PML and sheded epithelial cells.
- When the polymorphs increase the discharge becomes thick and yellowish.

- **Microscopic picture:**
- Mucosal cells appear swollen and rounded due to mucus accumulation (mucoid change) and may rupture or desquamate.
- The submucosa shows hyperemia, inflammatory edema and mild PML infiltration.

# Membranous inflammation (Pseudomembranous or Diphtheritic)

- **Definition:**
- Severe acute non suppurative inflammation characterized by the formation of a pseudo-membrane on the affected surface e.g. diphtheria and bacillary dysentery.

- **Pathogenesis:**
- The bacteria remain on the mucosal surface and produce powerful exotoxin which causes patchy mucosal necrosis.
- The exotoxin diffuses through the necrotic mucosa to the submucosa causing acute inflammation.
- The exotoxin is absorbed in the blood stream causing severe toxemia.

- **Gross picture:**
- Early the mucosa is congested and shows small grayish yellow patches of necrosis.
- Next a yellowish white slightly elevated pseudo-membrane is formed on the surface.
- The membrane is adherent and its removal leaves a bleeding surface with the formation of another membrane.

- **Microscopic picture:**
- The pseudo-membrane is formed of necrotic mucosal cells, bacteria and acute inflammatory cells held together by a fibrin network.
- The submucosa shows hyperemia, inflammatory edema, fibrin network and acute inflammatory cells in the form of PML, pus cells, macrophages and red cells.

# Sero-fibrinous inflammation

- **Definition:**
- Acute non suppurative inflammation characterized by the formation of excess fluid exudate rich in fibrinogen e.g. inflammation in serous sacs (pleura, pericardium and peritoneum).
- Next the visceral and parietal layers become thickened,  opaque, grayish yellow and reticulated due to fibrin deposition.

- If excess fibrin deposition occurs, inflammation is of the dry type.
- An inflammatory serous fluid collects in the serous sac.
- If excess serous fluid collects in the sac, inflammation is of the wet type.

- **Microscopic picture:**
- Serosal cells lining the visceral and parietal layers swell due to degeneration and desquamate leaving bare surfaces.
- An inflammatory fluid exudate rich in fibrinogen pours from the bare surfaces.
- The fibrinogen changes to fibrin forming a network on both the visceral and parietal layers entangling acute inflammatory cells (polymorphs, pus cells, macrophages and red cells).
- The subserosa shows hyperemia, inflammatory edema, fibrin network and acute inflammatory cells.

# Fibrinous inflammation

- **Definition:**
- Acute non suppurative inflammation characterized by an exudate rich in fibrinogen e.g. lobar pneumonia.

# Serous inflammation

- **Definition:**
- Acute non suppurative inflammation characterized by excess serous exudate e.g. mild buns and herpes simplex which show epidermal vesicles full of serous fluid containing few inflammatory cells.

# Hemorrhagic inflammation

- **Definition:**
- Acute non suppurative inflammation characterized by cellular exudate rich in the red blood cells due to vascular damage e.g. smallpox and hemolytic streptococcal infection.

# Necrotizing inflammation

- **Definition:**
- Acute non suppurative inflammation characterized by marked tissue necrosis e.g. cancrum oris and Vincent-angina.

# Allergic inflammation

- **Definition:**
- Acute non suppurative inflammation characterized by:

a. Tissue necrosis
b. Vascular dilatation, thrombosis, and destruction.
c. Cellular exudate formed mainly of neutrophils and eosinophils.
d. Contraction of smooth muscles e.g. bronchi and intestine.
e. Increased mucous secretion by mucous glands.

# CHRONIC INFLAMMATION

- **Chronic inflammation is characterized by the following:**

1. The irritant is mild and has a prolonged action.
2. It may follow acute inflammation or starts as slowly progressing chronic disease as in tuberculosis and syphilis.
3. The tissue response is gradual and prolonged. The response is basically the same as in acute inflammation.

4. Tissue necrosis is progressive and gradually replaced by fibrous tissue which appears at the periphery of the lesion.
5. Vascular dilatation and congestion are mild. Later on the small arteries and arterioles show thickening and narrowing by proliferation of the sub-intimal connective tissue. The change is called end arteritis obliterans.
6. The inflammatory fluid exudate is scanty.
7. The inflammatory cellular exudate takes either a diffuse or a perivascular arrangement.
8. The exudate shows the following types of inflammatory cells:

a) **Lymphocytes:** give rise to plasma cells and **liberate lymphokines.**
b) **Plasma cells:** form antibodies.
c) **Macrophages:** derived from blood monocytes and tissue histiocytes. Macrophages have the following functions:

- ❖ Phagocytosis of bacteria as tubercle bacilli and lepra bacilli.
- ❖ Phagocytosis of necrotic debris.
- ❖ Formation of giant cells.
- ❖ Secretory activity: Macrophages secrete or release proteases as collagenase and elastase, chemotactic factors, growth promoting factors, coagulation factors, monokines, complement components and interferon.

**d) Foreign body giant cells:**

- Formed by fusion of several macrophages or repeated division of the nucleus of a single macrophage without division of the cytoplasm (amitotic division).
- The cells are large.
- The number of nuclei from 2-100.
- They are rounded or oval and scattered in the cytoplasm or collected in the center.
- These cells may show phagocytic activity.

# Types of chronic inflammation

1. **Chronic non-specific inflammation:**

- Different irritants produce inflammatory reactions of the same microscopic picture.
- This type may follow acute inflammation, e.g. chronic abscess and chronic pyelonephritis.

2. **Chronic specific inflammation:**

- Each irritant produces inflammation of a characteristic microscopic picture e.g. tuberculosis and bilharziasis.

# GRANULOMAS

- **Definition:**
- Granuloma is a type of chronic specific inflammation characterized by focal accumulation of a large number of macrophages together with lymphocytes, plasma cells, giant cells and fibroblasts forming  tiny granules which fuse to form tumor-like masses.
- Macrophages come from outflow of blood monocytes which become immobilized, activated and divide by the action of lymphokines derived from activated T lymphocytes.

- **Types;**

1. **Infective granuloma:**

a. Bacterial: e.g. tuberculosis, leprosy and syphilis.
b. Parasitic: e.g. bilharziasis and leishmaniasis.
c. Fungal:e.g. madura foot.

2. **Non infective granuloma (foreign body granuloma):**

a. Silicosis and asbestosis.
b. Foreign body granuloma formed around pieces of wood or glass, catgut and talc powder……etc.

3. **Granuloma of unknown cause:**

a. Sarcoidosis
b. Regional enteritis.