

# Inflammation

## Definition

Comes from the latin word *inflammare* meaning to burn. First described by **Celsus** AD35

Four cardinal signs of inflammation:-

RED  
HOT  
SWOLLEN  
TENDER

- LOSS OF FUNCTION added by **Galen** (130-200AD)

- Inflammation is the local physiological response to injury.
- Inflammation itself is not a disease, it is a reaction to disease.
- Inflammation is classified according to its time course.
- **Acute Inflammation:**  
Initial and often transient series of tissue reactions to injury.
- **Chronic Inflammation:**  
The subsequent and often prolonged tissue reactions following the initial response.
- Acute and chronic inflammation is also characterised by the difference in cell types participating in the inflammatory response

### Principal Causes Of Acute Inflammation

A wide variety of causitive agents are associated with cellular injury/death....

- Trauma
- Thermal (extremes of cold/heat)
- Poison
- Drugs
- Infectious disease (commonest cause of inflammation)
- Ionising radation
- Auto immune reactions

- **Trauma/Thermal:**
  - Tissue damage as a result of physical blows etc.
  - burns/frostbite (hot/cold packs...)
- **Poison/Chemical:**
  - Direct trauma/inhalation/absorbtion
- **Drugs:**
  - over dose/adverse reactions/interactions
- **Infectious disease**
  - Viruses lead to the death of individual cells, bacteria release specific toxins
- **Auto immune:**
  - Hypersensitivity occurs when there is an altered state of immunological response...

## Acute Inflammation

Is characterised by:

Initial reaction of tissue to injury.

Vascular component: dilation of vessels.

Exudate component: vascular leakage of protein rich fluid.

Neutrophil polymorph is the characteristic cell recruited to the tissues.

Outcome may be:

- **Resolution**
- **Suppuration**
- **Organisation**
- **Progression To Chronic Inflammation**

- Acute inflammation is the tissue reaction to a wide range of injurious agents.
- Lasts hours - days
- The process is usually described by the suffix "itis" preceded by the name of the organ.
  - i.e. Hepatitis - liver disease
- the acute inflammatory responses is similiar no matter what the causitive agents.

**Mechanism Of Cellular Injury**

- Cells may be damage reversibly or irreversibly. the effect on a tissue depends on.....
- Duration of injury
- Nature of injurious agent
- Proportion and type of cells affected
- Ability of damaged tissue to repair

**Early Stages Of Acute Inflammation**

- The acute inflammatory response involves 3 stages....
- Changes in vessel size (dilation) and consequently increased blood flow
- Increased vascular permeability and formation of fluid exudate
- Emigration of the neutrophil polymorphs into the extravascular spaces

**The Triple Response**

**Flush, Flare, Wheal (Lewis, 1927)**

Take a blunt instrument and draw a line on your forearm.....

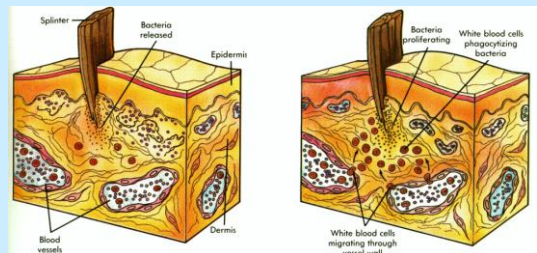
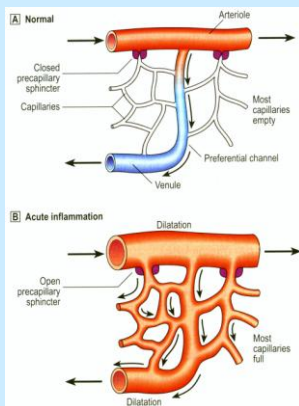
- Momentary white line....due to arteriolar vasoconstriction in response to injury
- Flush....capillary dilation
- Flare.....red irregular zone that develops due to arteriolar dilation
- Wheal...a zone of odema (swelling) due to fluid exudation

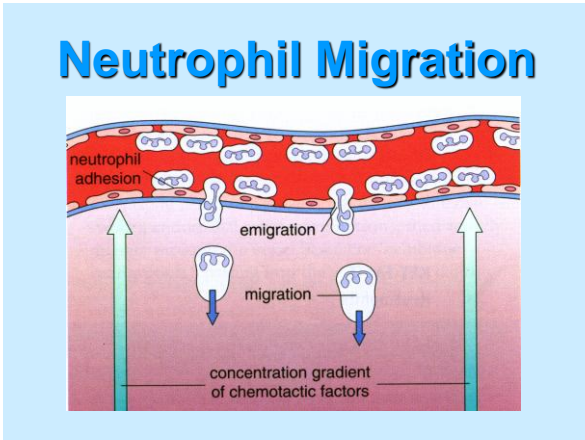
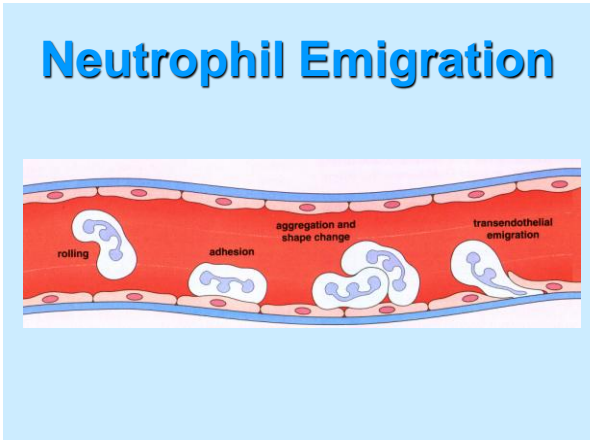
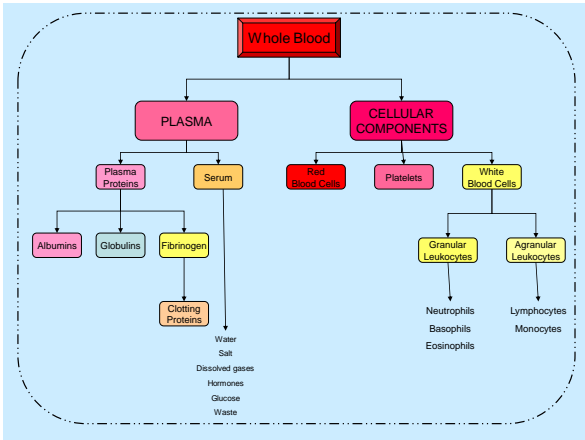
**Exudation**

The escape of protein rich fluid is called EXUDATION. The escaping fluid, EXUDATE.

Fluid exudate:

- Exudate fluid is high in protein.
  - immunoglobulins - neutrophils/leukocytes
  - for the destruction of invading organisms
  - co-agulation (clotting)
- RBC may also escape
  - usually means a tear in the vessel wall





## Later Stages Of Acute Inflammation

- Chemotaxis of neutrophils...  
Definition: - The attraction of a substance towards a chemical substances in solution.

These chemical substances are called **MEDIATORS** (of inflammation)

Neutrophil polymorphs are attracted to

- Cytokines
- Complement
- Chemicals produced by the neutrophils themselves

## Chemical Mediators Of Acute Inflammation

- Histamine
  - Best known mediator...causes vasodilation
- Lysosomal compounds
  - Released from neutrophils...increase vascular permeability
- Prostaglandins
  - Potentiate increased vascular permeability...nerve ending irritant
  - Aspirin inhibits prostaglandin production
- Leucokines
  - vasoactive properties
- Serotonin
  - Present in high concentration in platelets
  - Potent vasoconstrictor
- Chemokines
  - Attract leucocytes to area of inflammation
- Plasma Factors
  - Plasma contains 4 enzymatic cascade systems
- Complement
- The Kinins
- The Coagulation Factor
- The Fibrinolytic System

## Beneficial Effects of Inflammation

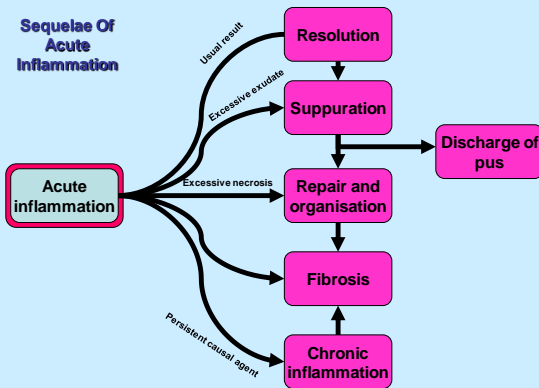
- Dilution of toxins
  - Allowing them to be carried away in the lymphatics
- Entry of Antibodies
  - Increase vascular permeability allows antibodies to circulate and neutralise toxins
- Transport of drugs
  - to sites where bacteria are multiplying

- **Fibrin formation**
  - Traps micro-organisms
- **Delivery of nutrients**
  - To essential cells with a high demand eg. neutrophils
- **Stimulation of immune response**
  - By draining into the lymphatics where local lymph nodes stimulates immune response...(Lymphadenopathy)

## Harmful Effects Of Acute Inflammation

- **Digestion of normal tissue**
  - Enzymes digest normal tissue leading to their unnecessary destruction
- **Swelling**
  - In confined areas....Throat/head
- **Inappropriate inflammatory response**
  - allergic reactions
  - toxic shock syndrome

### Sequelae Of Acute Inflammation



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### Resolution:

- Minimal cell death & tissue damage
- Occurance in an organ which has regeneration capacity
- Rapid destruction of causal agent
- Rapid removal of fluid & debris

### Suppuration:

- Formation of **pus**
  - a mixture of living/dying/dead neutrophils & bacteria
  - Virtually always infective agent
  - Once pus begins to form a membrane surrounds it = **ABCESS**
  - Difficult for antibiotics to get at an abscess

### Organisation:

- Replacement Of damaged tissue by granulation tissue
- Scar tissue
- Fibrosis

## Systemic Signs Of Inflammation

Apart from local features acute and chronic inflammation produce systemic effects.

- **Pyrexia**
  - increased temperature
- **Constitutional Symptoms**
  - Tiredness (**Malaise**)
  - Lack of appetite (**Anorexia**)
  - Nausea
- **Weight Loss**
  - Dehydration
  - Not replenishing fat reserves

## • Lymphadenopathy

- swollen lymphnodes due to increased activity

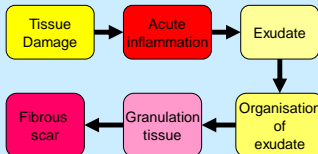
## • Haematological Changes

- Raised **ESR (Erythrocyte Sedimentation Rate)**
  - Anemia
    - Blood loss
    - RBC supression ..... due to toxins
- (referred to the "Anemia of chronic disease")

## Chronic Inflammation

- When a damaging stimulus persist, complete healing cannot occur, and chronic inflammation ensues.

- The sequence of...



- If the causative agent persist, the process of continuing tissue necrosis, organisation and repair all occur together.

- In addition to acute inflammation, the specific immune system is activated around the area of damage, and the tissues are infiltrated by lymphoid cells (Lymphocytes).

- Chronic inflammation will persist until the causative agent is removed or neutralised.

- Chronic inflammation is a balance between tissue repair and continued tissue damage.

- ⊙ If damaging stimulus is neutralised or eradicated, further tissue necrosis does not occur and the repair response progresses to complete scarring.

- ⊙ If damaging stimulus cannot be eradicated or neutralised, the balance between tissue damage and tissue repair is maintained in a stalemate and chronic inflammation will persist.

**Chronic inflammation differs from acute inflammation in that different cells are involved in the inflammatory process.**

