Foundation Block
Pathology

INFLAMMATION AND REPAIR

Lecture 1

Definition of inflammation

Acute Inflammation

Vascular Events in Inflammation

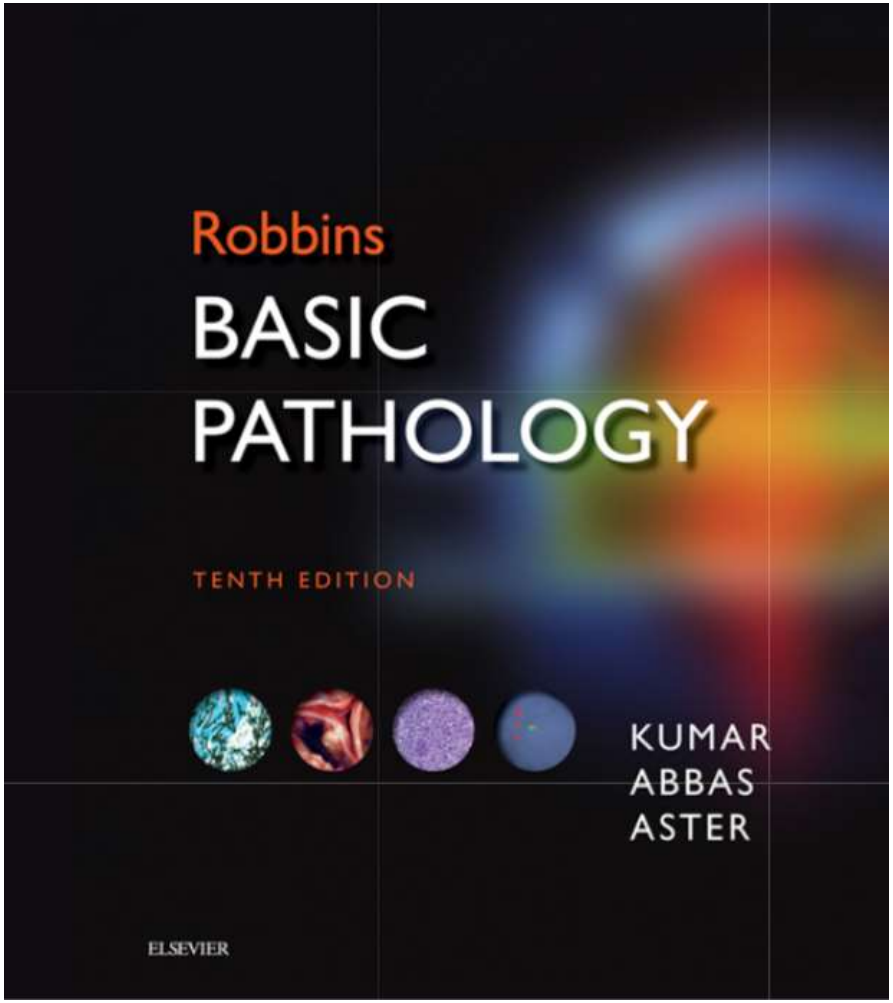
Lecturer: Dr. Maha Arafah

Learning Objectives:

1. **Define inflammation**
2. **List cells & molecules that play important roles in inflammation**
3. **Types of inflammation: acute and chronic inflammation**
4. **Recognize the cardinal signs of inflammation**
5. **Describe the sequence of vascular changes in acute inflammation (vasodilation, increased permeability) and their purpose**
6. **Compare normal capillary exchanges with exchange during inflammatory response**
7. **Define the terms edema, transudate, and exudate.**

Reference book and the relevant page numbers..

- Robbins Basic Pathology 10th edition
- Page: 57 - 60



1. Define inflammation.

What is Inflammation?

- Inflammation is a local response of the vascularized living tissue to infection and damaged tissue that brings cells and molecules of host defense from the circulation to the sites where they are needed

The aim: to localize and eliminate the causative agents, limit tissue injury and restore tissue to normal

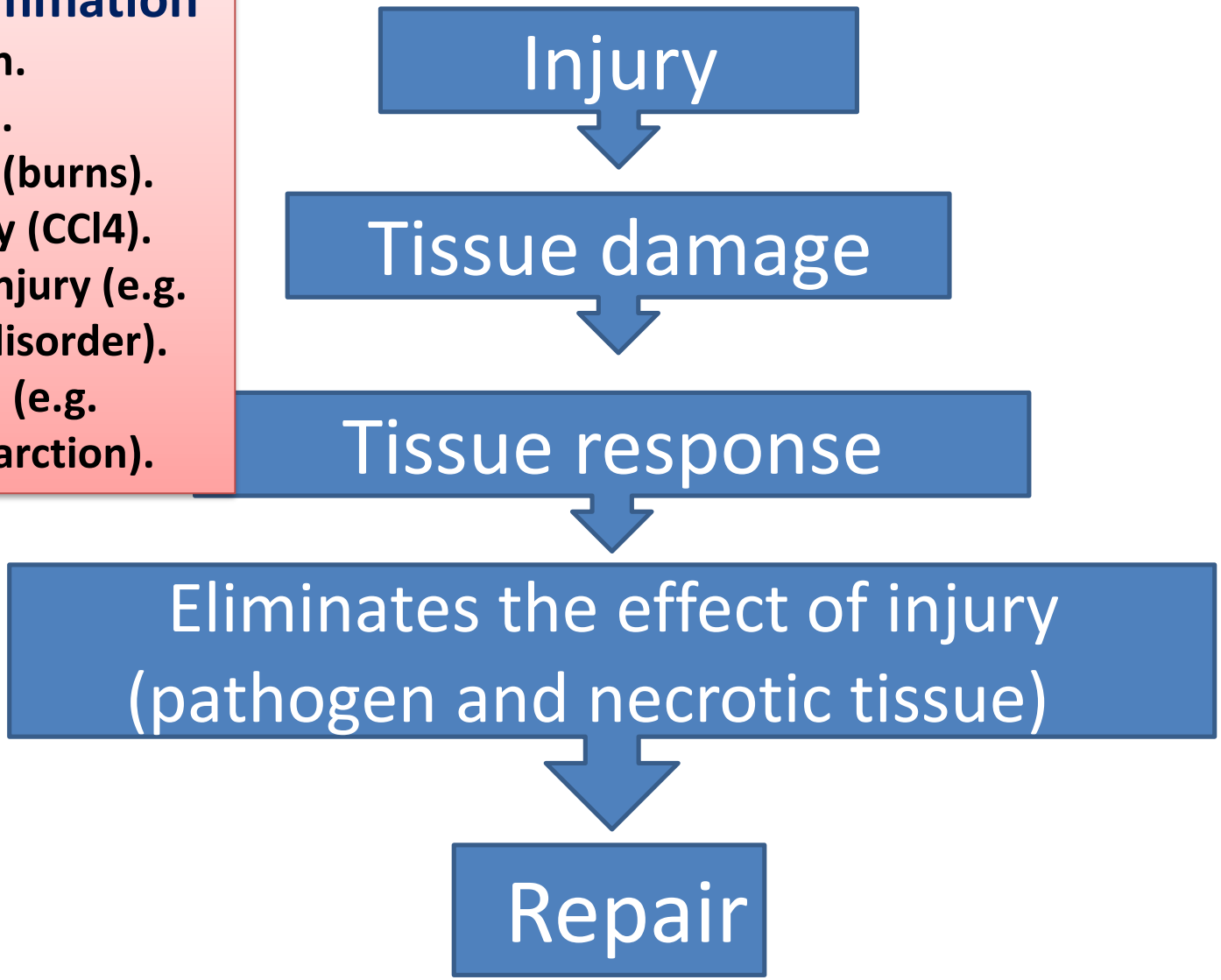
➔Therefore, Inflammation is part of immunity:
This is a broad protective response

➔*(innate immunity)*

1. Define inflammation: its causes and steps

Causes of Inflammation

Infection.
Trauma.
Physical injury (burns).
Chemical injury (CCl_4).
Immunological injury (e.g. Auto-immune disorder).
Tissue death (e.g. Myocardial infarction).



1. Define inflammation.

Steps of inflammation

The offending agent is recognized by host cells and molecules.

↓

Leukocytes and plasma proteins are recruited from the circulation to the site where the offending agent

↓

The leukocytes and proteins are activated to destroy and eliminate the offending substance.

↓

The reaction is controlled and terminated.

↓

The damaged tissue is repaired.

1. Define inflammation.

Can inflammation be harmful ! ?

Disorders	Cells and Molecules Involved in Injury
Acute	
Acute respiratory distress syndrome	Neutrophils
Asthma	Eosinophils; IgE antibodies
Glomerulonephritis	Antibodies and complement; neutrophils, monocytes
Septic shock	Cytokines

1. Define inflammation.

Inflammation

- Inflammation is terminated when the offending agent is eliminated and the secreted mediators are broken down or dissipated.

There are active anti-inflammatory mechanisms that serve to control the response and prevent it from causing excessive damage to the host.

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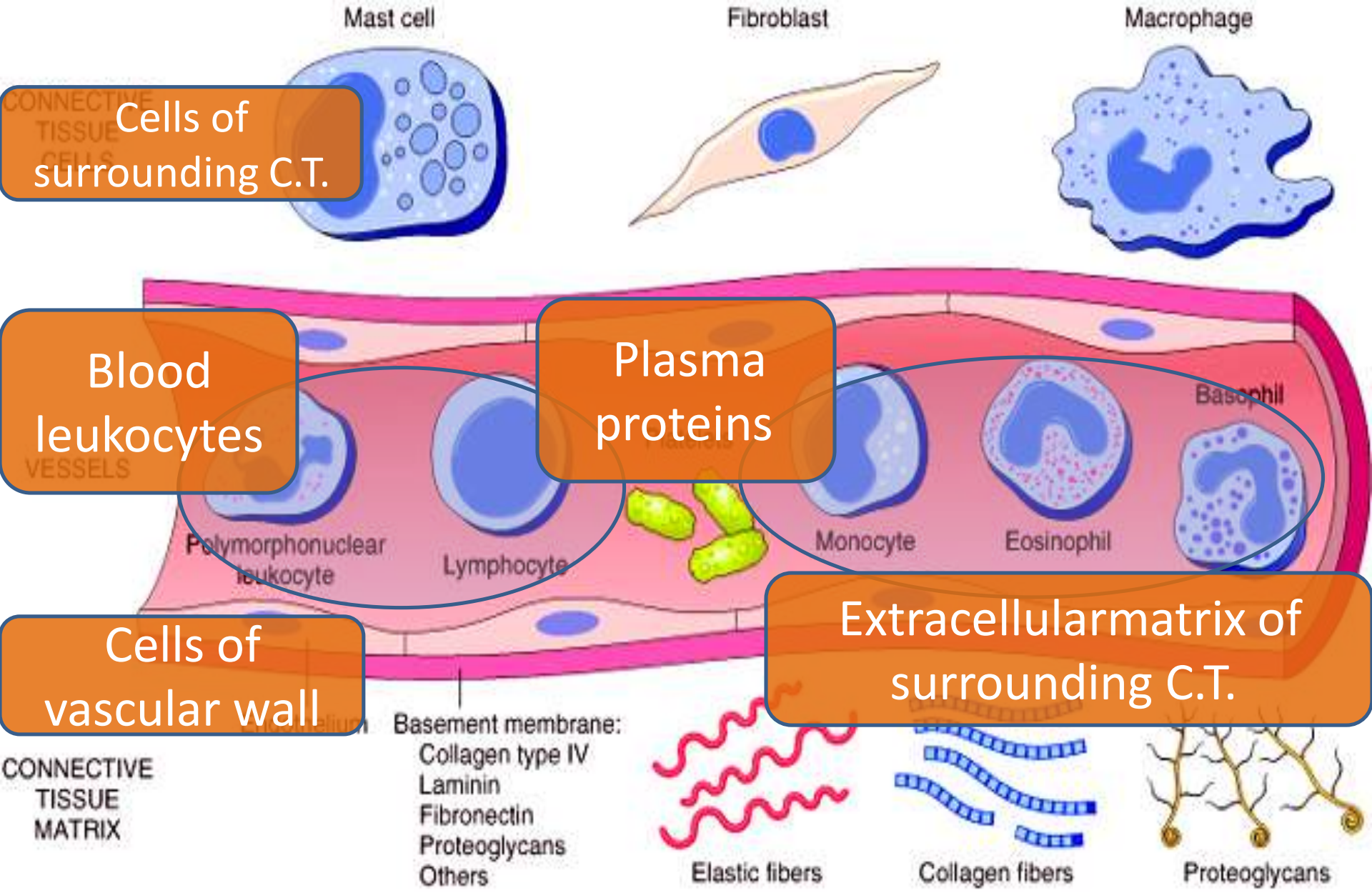
2. List cells & molecules that play important roles in inflammation



2. List cells & molecules that play important roles in inflammation

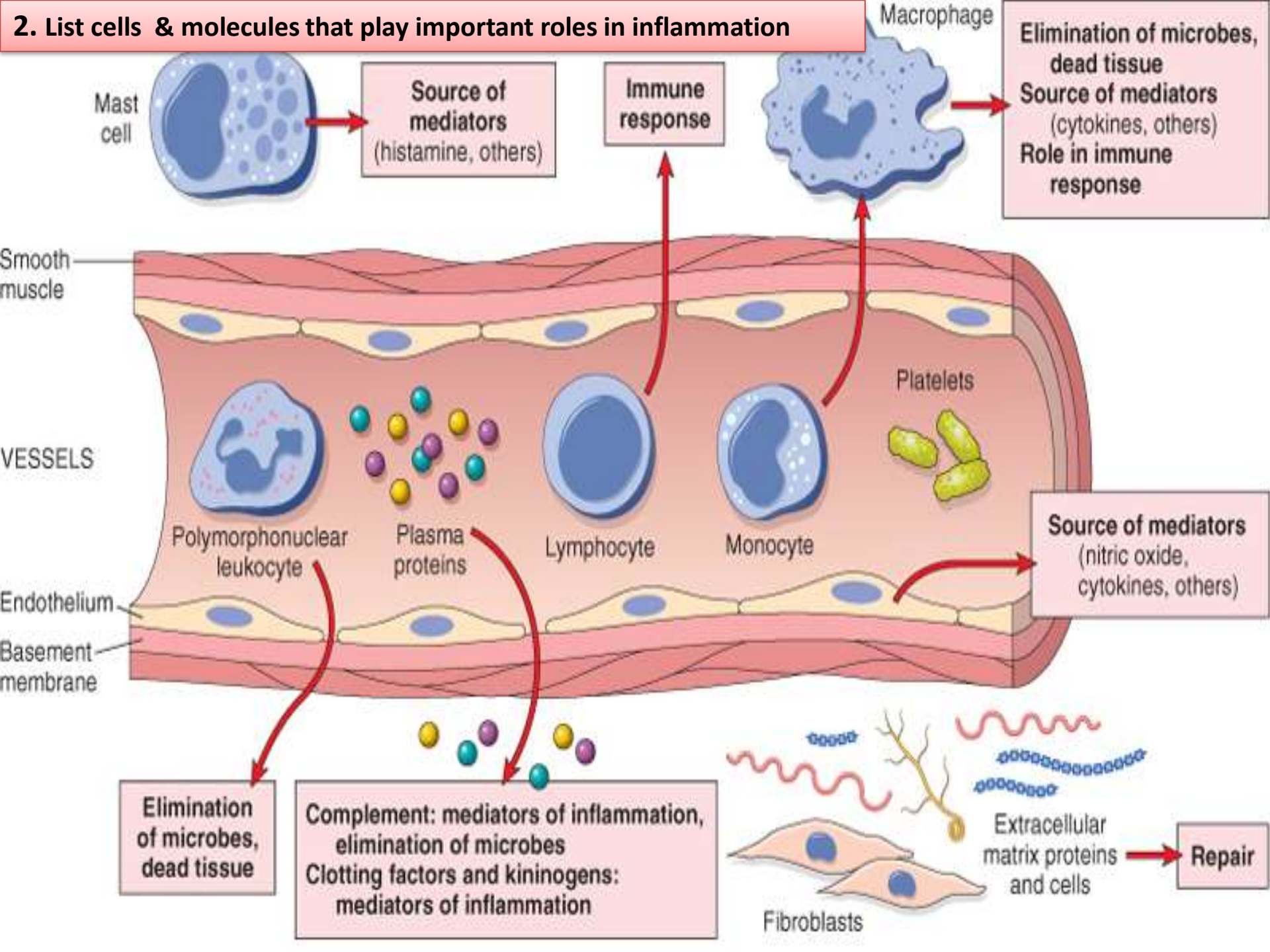
Inflammation is mediated by chemical substances called

CHEMICAL MEDIATORS

What is the source of these chemical mediators?

1. Phagocytes and other host cells
   Leukocyte
   Endothelium
   Mast cell
2. Plasma proteins

2. List cells & molecules that play important roles in inflammation



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TYPES OF INFLAMMATION

Acute inflammation

Chronic Inflammation

3. Compare between acute and chronic inflammation

Features of acute and chronic inflammation

Feature	Acute	Chronic
Onset	**Fast : minutes or hours**	**Slow : days, weeks**
Cellular infiltrate	**neutrophils**	**lymphocytes and macrophages**
Tissue injury, fibrosis	**Mild, self limited**	**Often sever & progressive**
Local & systemic signs	**Prominent**	**Less prominent, may be subtle**

Acute inflammation

- A rapid response to an injurious agent that serves to deliver mediators of host defense-leukocytes and plasma proteins-to the site of injury

The outcome of acute inflammation

is either

- elimination of the noxious stimulus, followed by decline of the reaction and repair of the damaged tissue

or

- persistent injury resulting in chronic inflammation

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4. Recognize the cardinal signs of inflammation

Clinical Features

The 5 ancient cardinal signs of inflammation are

Tumor:-swelling

Due to a histamine-mediated increase in permeability of the venules

Rubor :– redness

Calor: – warmth

Rubor and calor are due to histamine-mediated vasodilation of arterioles

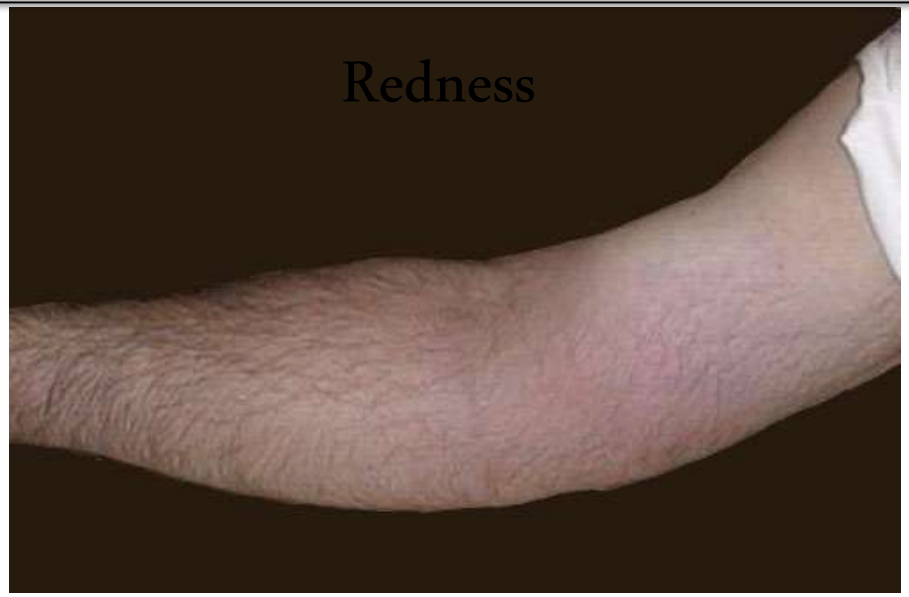
Dolor :– pain

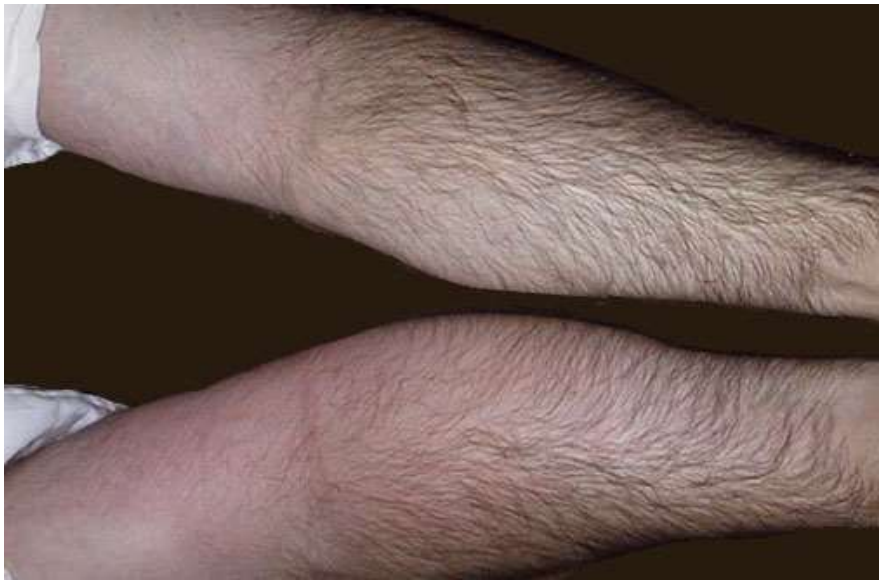
mediated by PGE2 and bradykinin

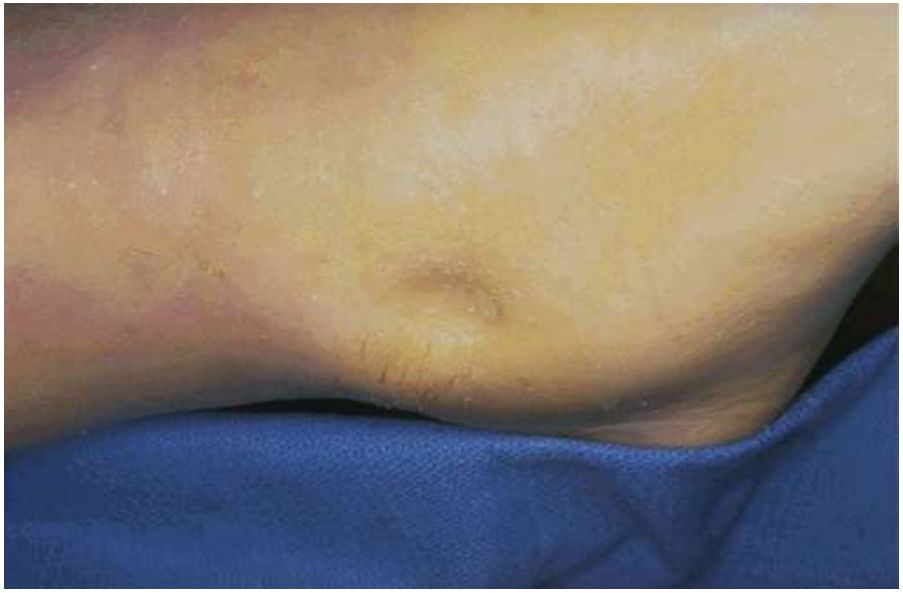
Functio Laesa :– loss of function

The suffix "its" is added to the base word to state the condition as in appendix/appendicitis

4. Recognize the cardinal signs of inflammation







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Events of acute Inflammation

- Acute inflammation has three main events:

vascular

(1) Hemodynamic changes

(*alterations in vascular caliber that lead to an increase in blood flow)*

(2) Increased vascular permeability

(*structural changes in the microvasculature that permit plasma proteins and leukocytes to leave the circulation)*

cellular

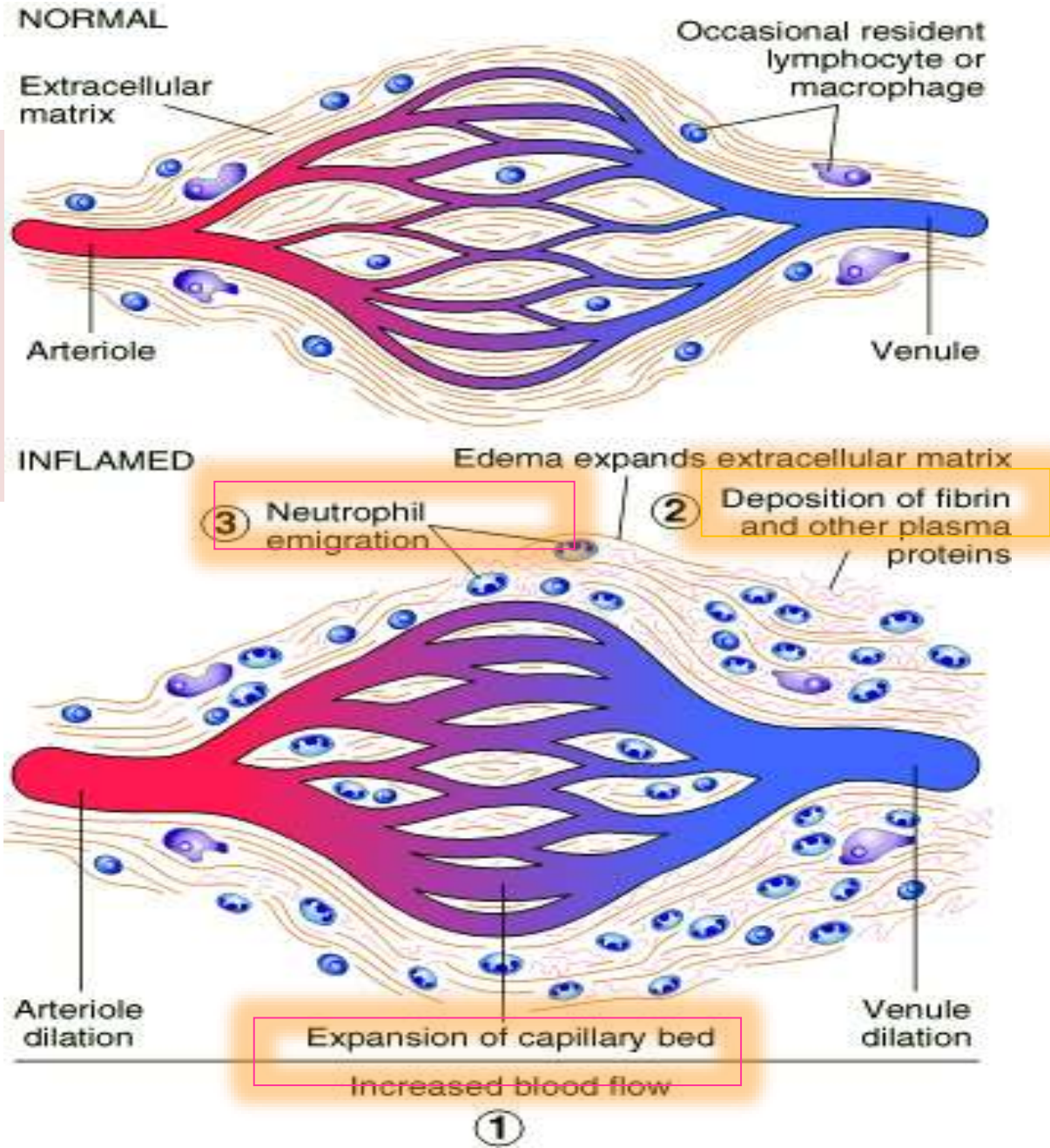
(3) Emigration of the leukocytes from the microcirculation

(their accumulation in the focus of injury, *and their activation* to eliminate the offending agent)

5. Describe the sequence of vascular changes in acute inflammation

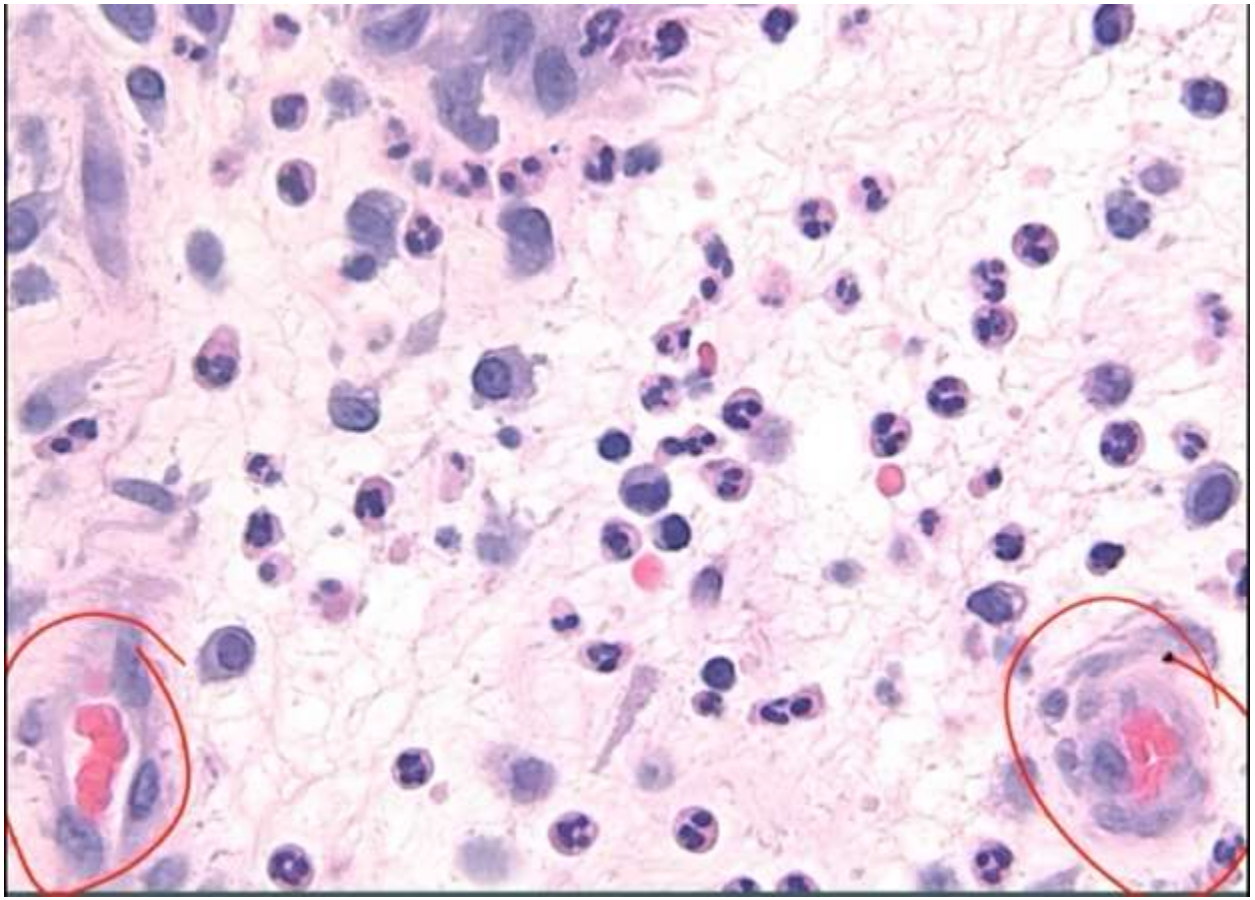
Sequence of vascular events in acute inflammation:

1. Reflex vasoconstriction
2. Vasodilatation/Vasodilation
3. Increased capillary permeability



5. Describe the sequence of vascular changes in acute inflammation

1. Hemodynamic changes



5. Describe the sequence of vascular changes in acute inflammation

1. Hemodynamic changes

Phases of changes in Vascular Caliber and Flow

1. Transient vasoconstriction of arterioles
2. Vasodilatation
3. Slowing of the circulation
4. Stasis

5. Describe the sequence of vascular changes in acute inflammation

1. Hemodynamic changes

Phases of changes in Vascular Caliber and Flow

1. Transient vasoconstriction of arterioles

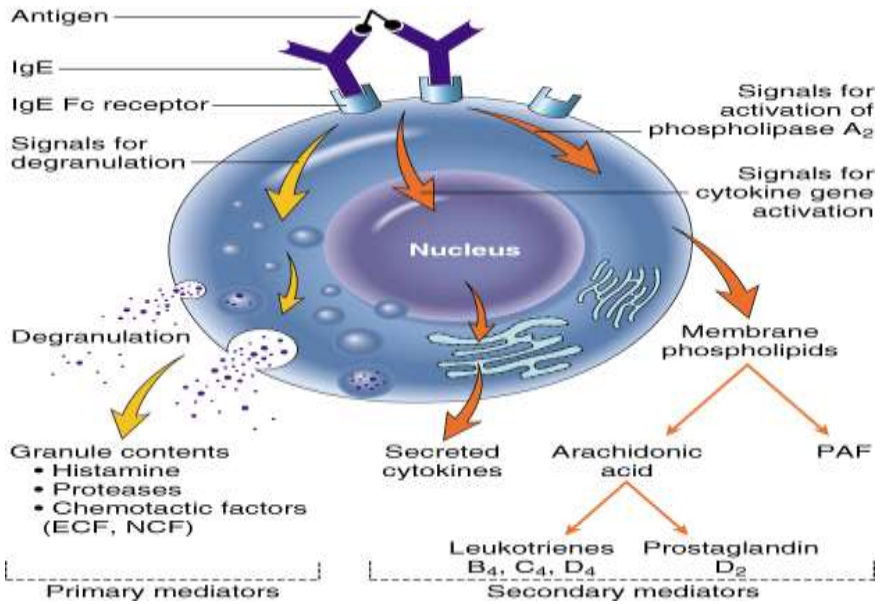
It disappears within 3-5 seconds in mild injuries

(Due to a neurogenic reflex that lasts only a few seconds)

2. Vasodilatation:

It involves the **arterioles** results in opening of new microvasculature beds in the area leading to increasing blood flow and cause of redness and hotness in acute inflammation

(Due to Histamine effect released from mast cells located in interstitial tissue around the small vessels)



5. Describe the sequence of vascular changes in acute inflammation

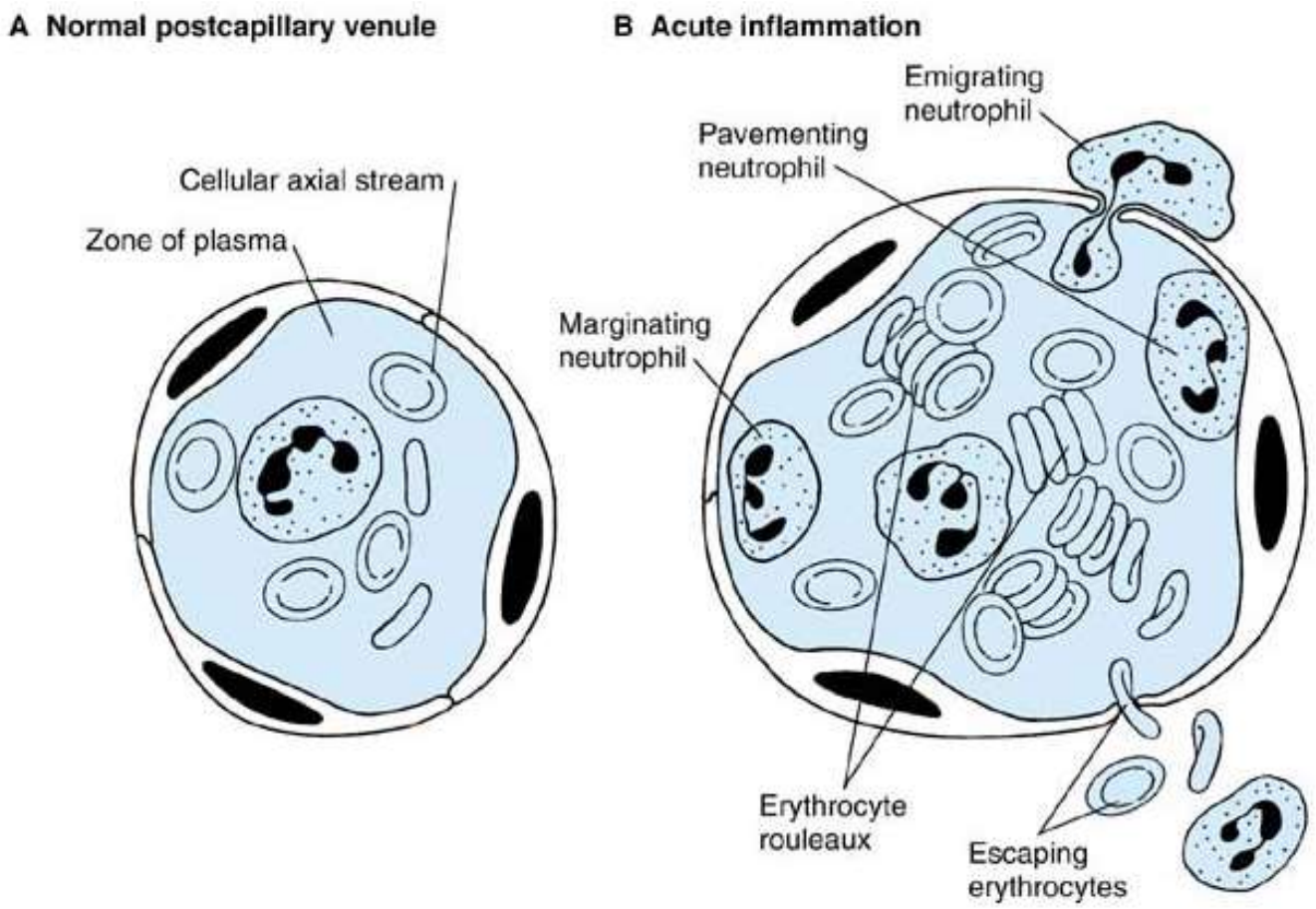
1. Hemodynamic changes

Phases of changes in Vascular Caliber and Flow

3. Slowing of the circulation

due to increased permeability of the microvasculature, this leads to outpouring of protein-rich fluid in the extravascular tissues.

4. Stasis: slow circulation due to dilated small vessels packed with red cells



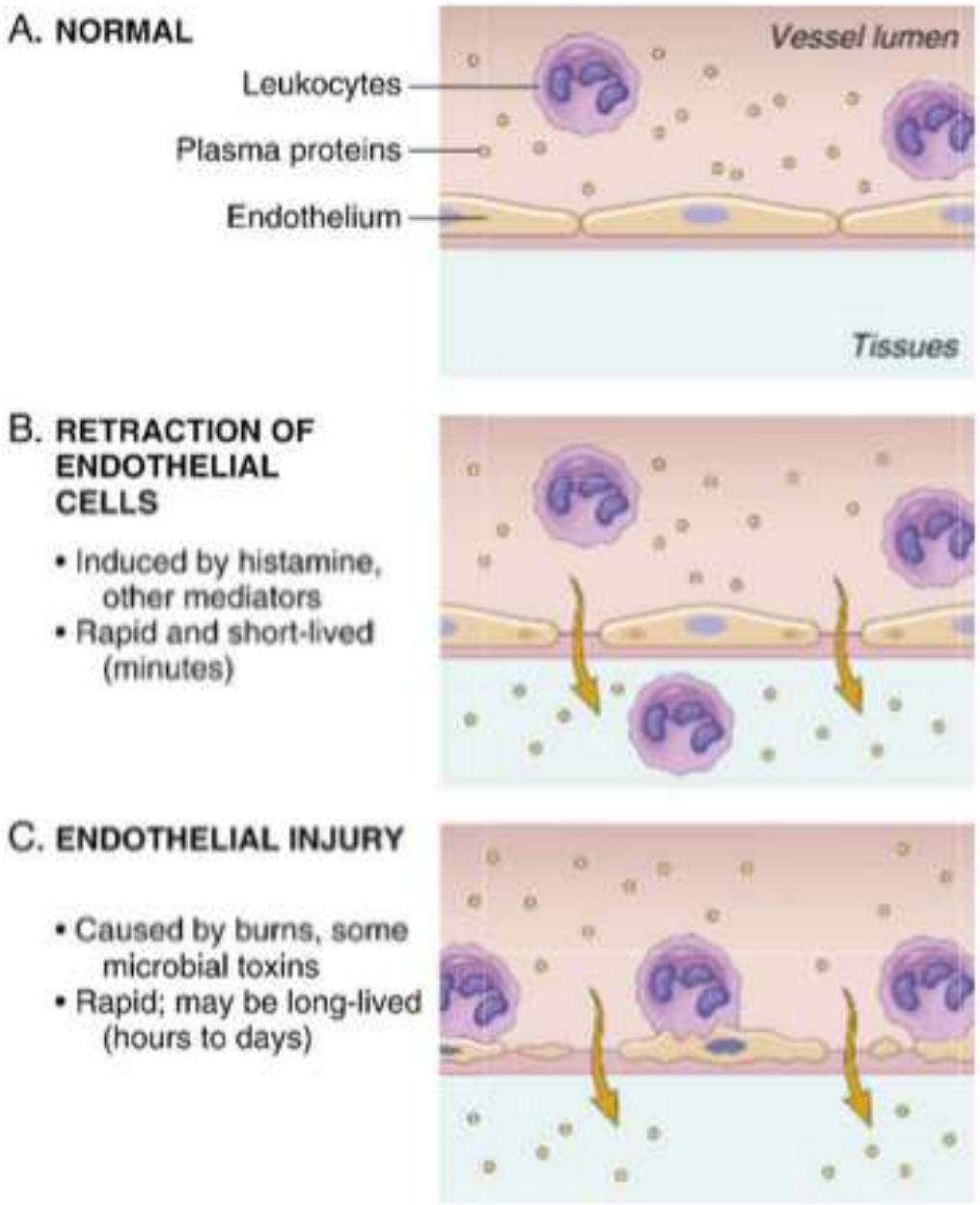
5. Describe the sequence of vascular changes in acute inflammation

Vascular Events

2. Increased Vascular Permeability

- A hallmark of acute inflammation (escape of a protein-rich fluid).
  - induced by histamine, kinins, and other mediators
- It affects small & medium size venules, through gaps between endothelial cells
- It result in swelling (tumor) which occurs as a cardinal sign of inflammation

5. Describe the sequence of vascular changes in acute inflammation



Principal mechanisms of increased vascular permeability in inflammation and their features and underlying causes

venules

Arteriols, capillaries and venules

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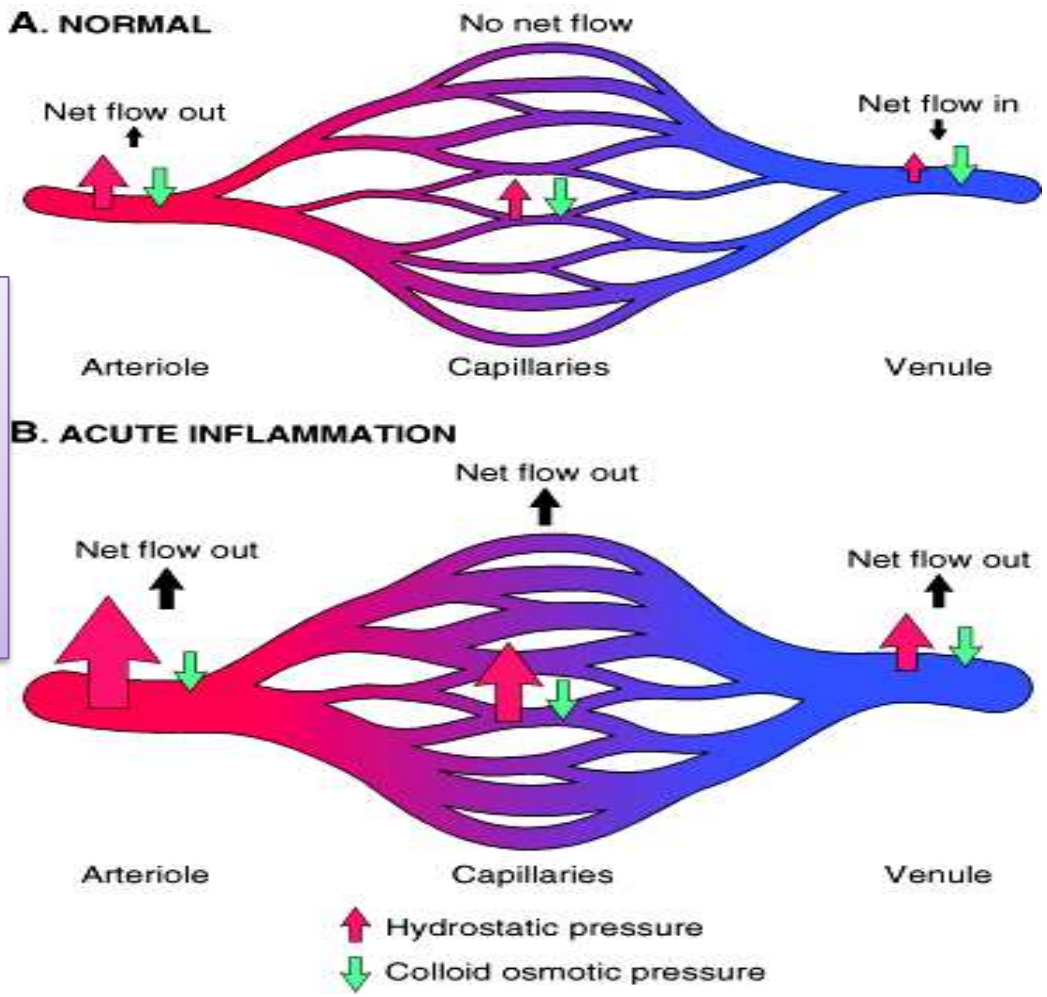
Increased blood volume lead to increased local hydrostatic pressure leading to transudation of protein-poor fluid into the extravascular space.

What is the edema?

denotes an excess of fluid in the interstitial or serous cavities

- It can be either an **exudate or a transudate**



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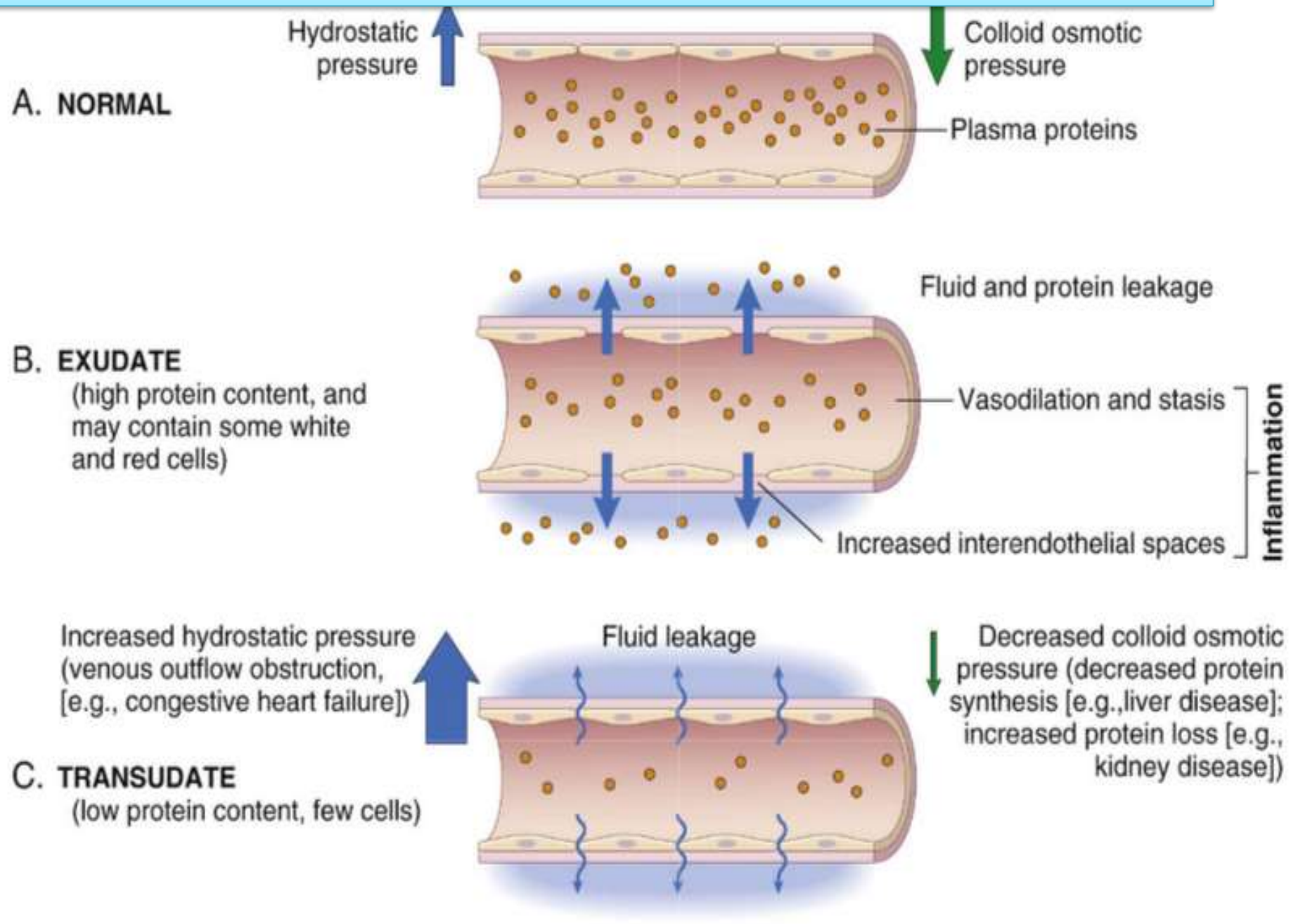

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Edema is defined as an excess of fluid in the interstitial space.

What is the difference between transudates and exudates?

Transudate

is a fluid with low protein content and a specific gravity of less than 1.012

It is essentially an ultrafiltrate of blood plasma that results from osmotic or hydrostatic imbalance across the vessel wall

without an increase in vascular permeability

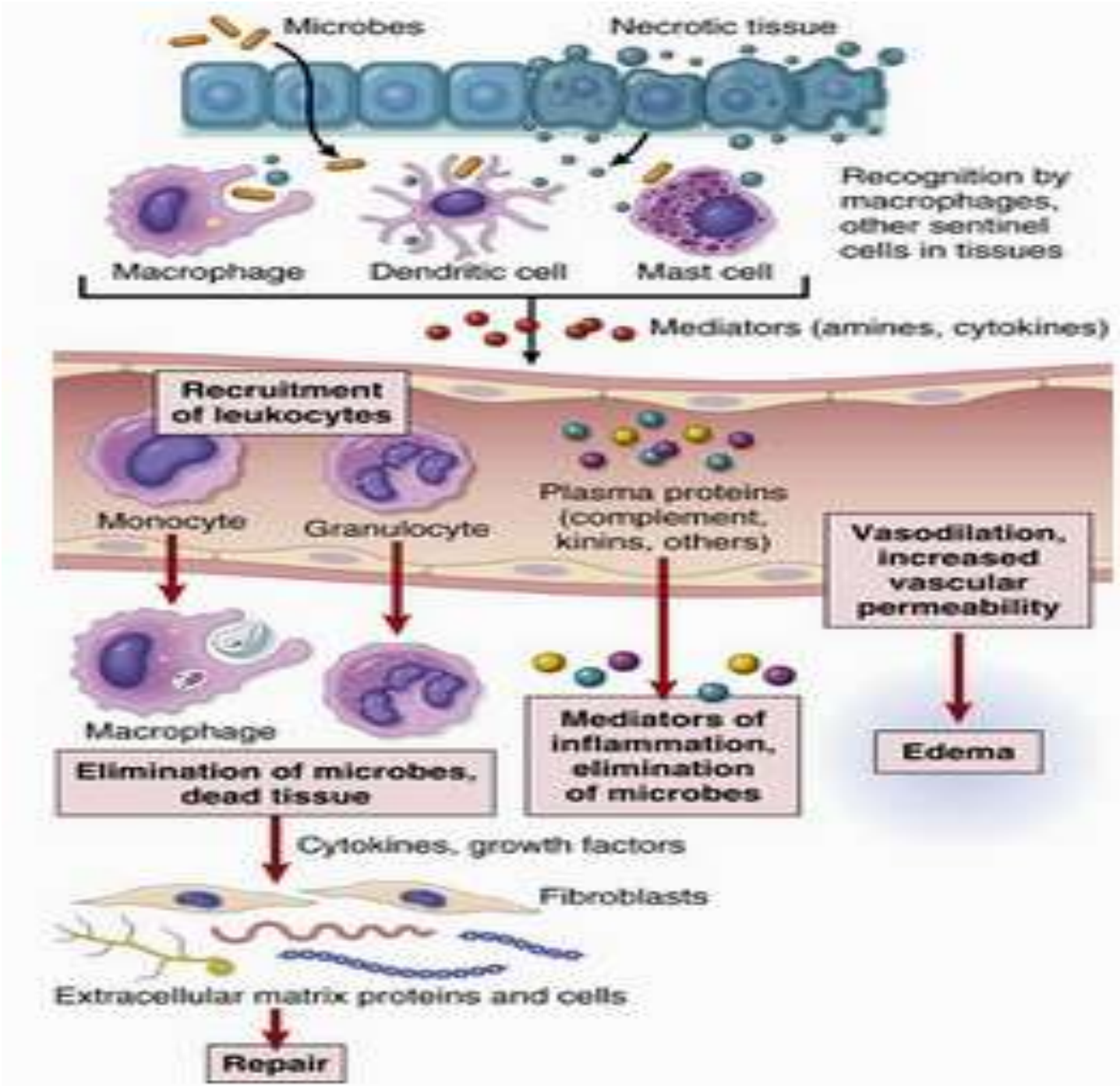
Exudate

An inflammatory extravascular fluid that has a high protein concentration, cellular debris, and a specific gravity above 1.020

It implies significant alteration in the normal permeability of small blood vessels in the area of injury

TAKE HOME MESSAGES

- Inflammation, the local response of the vascularised living tissue to injury.
- Could be acute or chronic.
- Several cells & molecules that play important roles in inflammation.
- Inflammation has vascular and cellular events to eliminate the cause.
- Vascular events include vasodilation and increased permeability to deliver a protein rich fluid to the site of inflammation.


Microbes
Necrotic tissue
Recognition by macrophages, other sentinel cells in tissues
Macrophage
Dendritic cell
Mast cell
Mediators (amines, cytokines)
Recruitment of leukocytes
Monocyte
Granulocyte
Plasma proteins (complement, kinins, others)
Vasodilation, increased vascular permeability
Macrophage
Elimination of microbes, dead tissue
Mediators of inflammation, elimination of microbes
Edema
Cytokines, growth factors
Fibroblasts
Extracellular matrix proteins and cells
Repair