

INFLAMMATION AND REPAIR

Lecture 1

Definition of inflammation

Acute Inflammation

Vascular Events in Inflammation

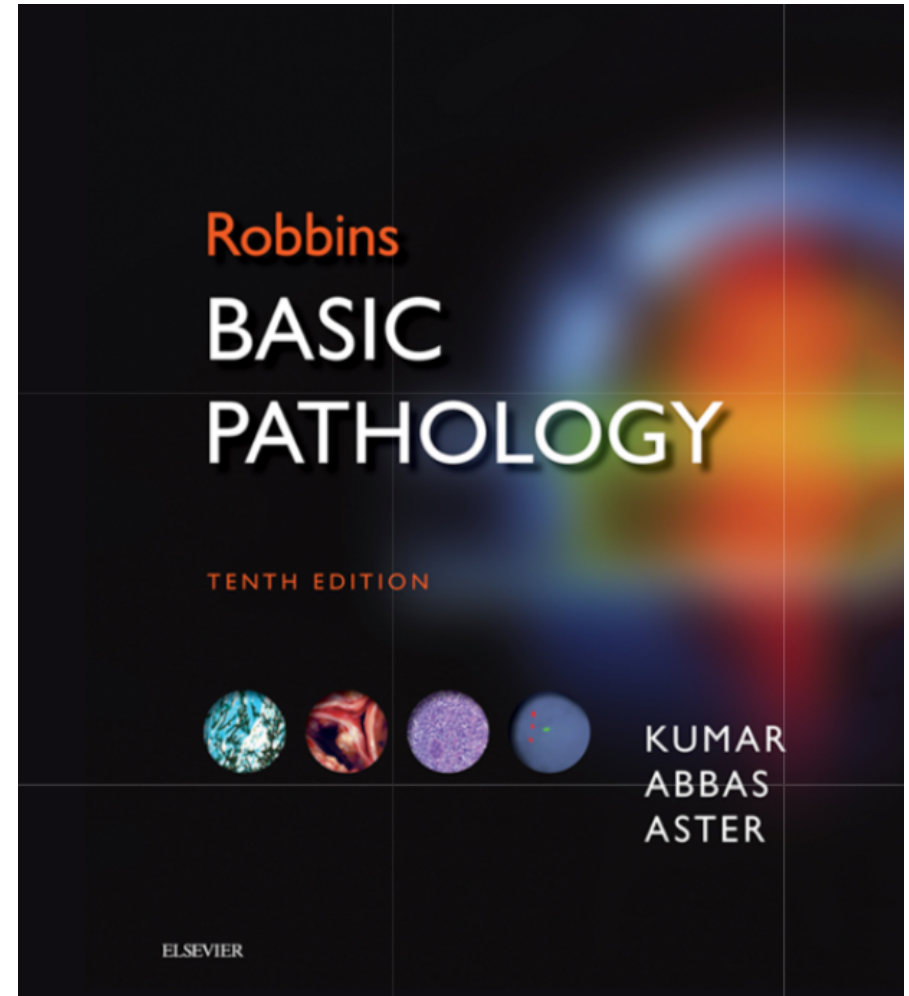
Lecturer: Dr. Maha Arifah

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



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 (CCl₄).

Immunological injury (e.g.

Auto-immune disorder).

Tissue death (e.g.

Myocardial infarction).

Injury

Tissue damage

Tissue response


Eliminates the effect of injury
(pathogen and necrotic tissue)

Repair

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

Inflammation

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

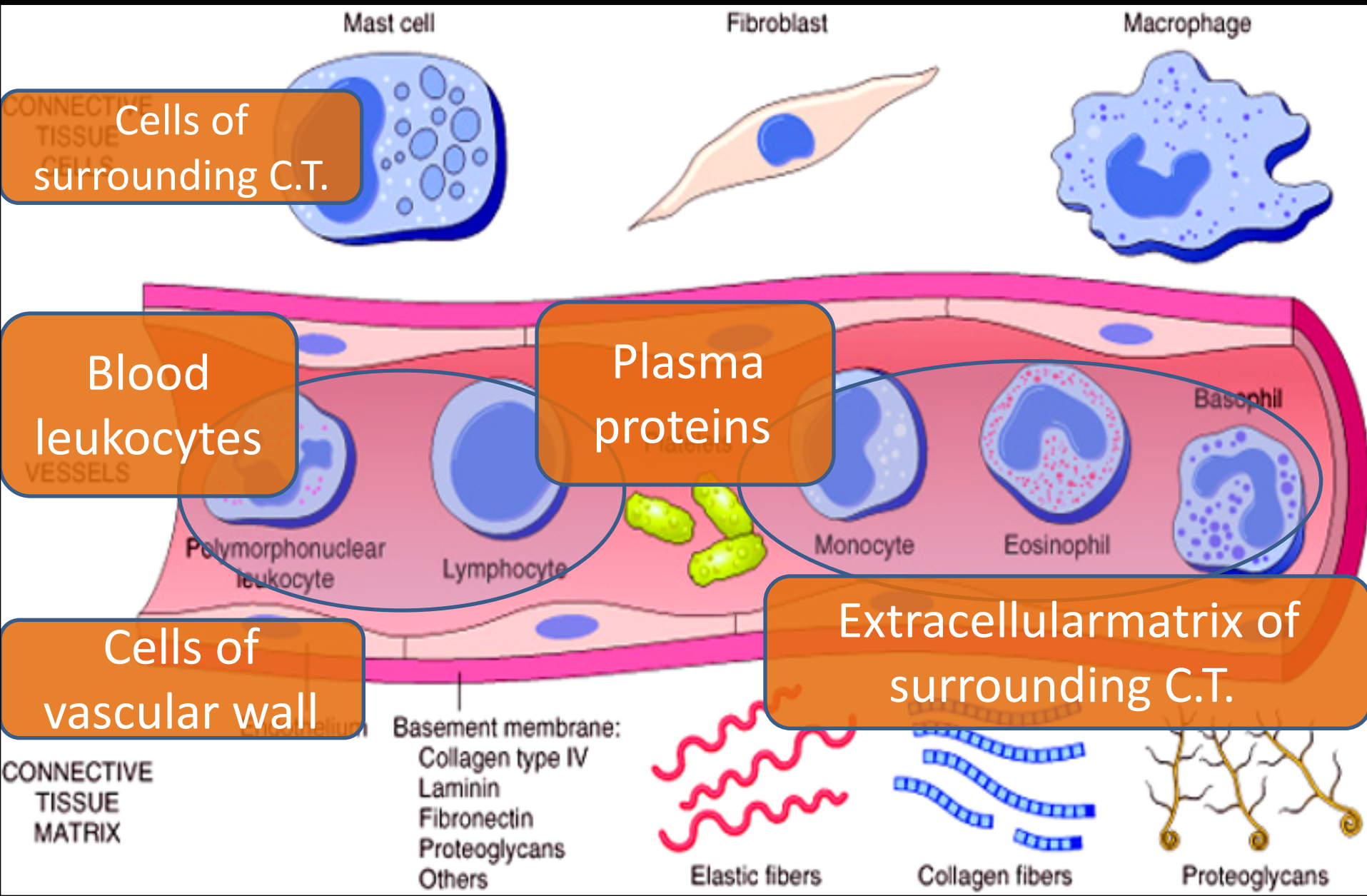
There are active anti-inflammatory mechanisms that serve to control the response and prevent it from causing excessive damage to the host.

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



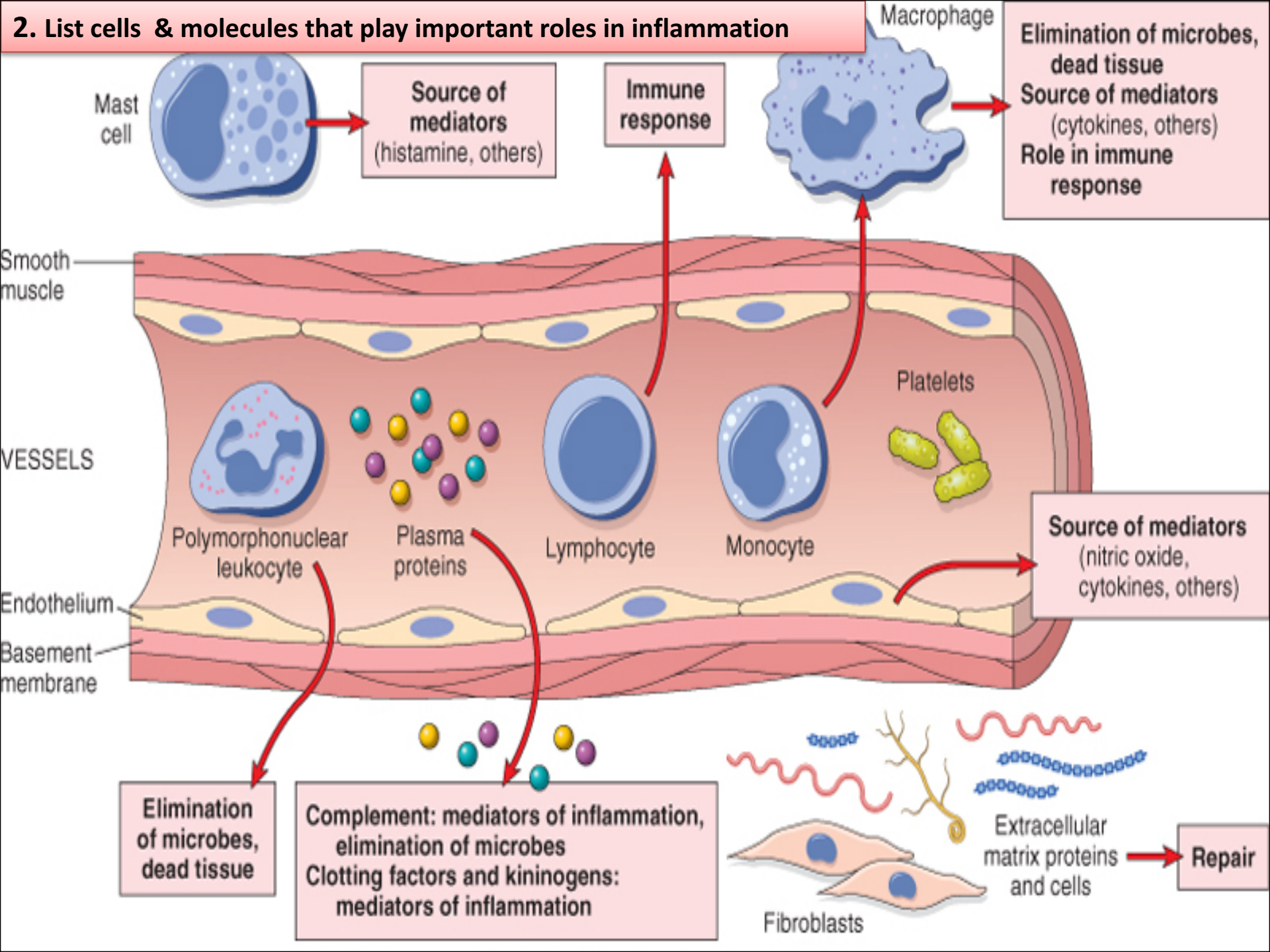
Inflammation is mediated by
chemical substances called

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		
Cellular infiltrate		
Tissue injury, fibrosis		
Local & systemic signs		

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 venules

Rubor :- redness

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

Calor: – warmth

Dolor :- pain

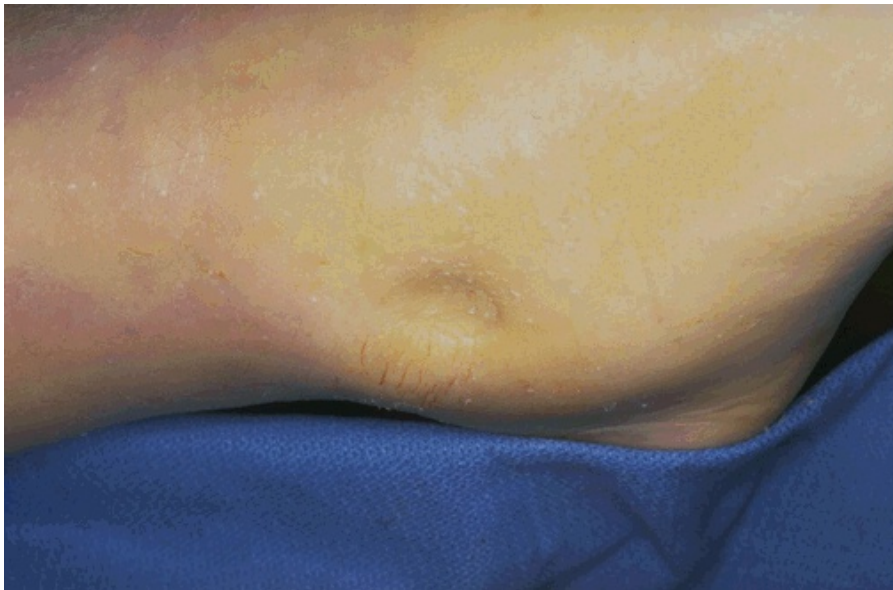
mediated by PGE2 and bradykinin

**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

Redness



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Events of acute Inflammation

- Acute inflammation has three main events:

(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)

(3) Emigration of the leukocytes from the microcirculation

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

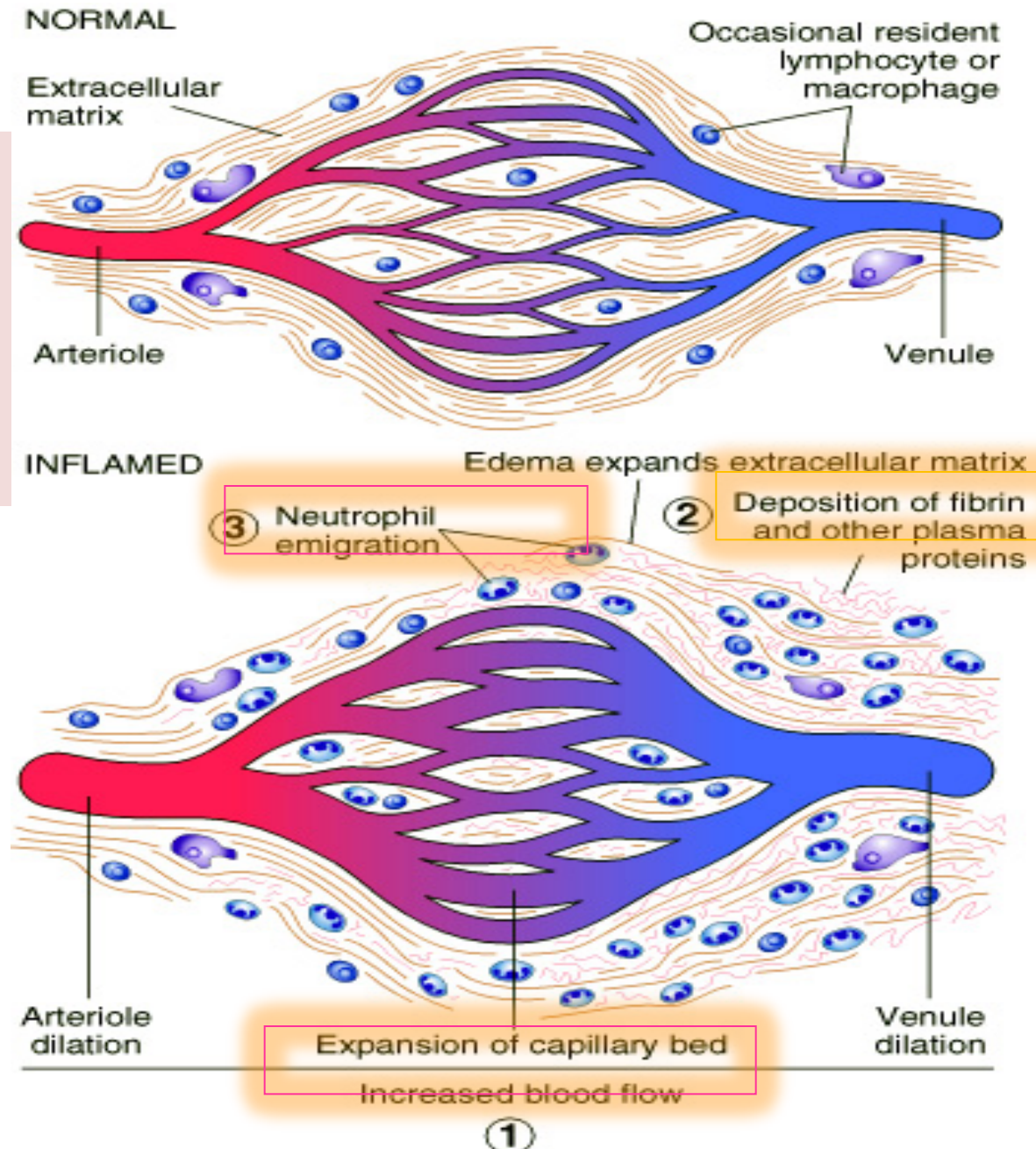
vascular

cellular

5. Describe the sequence of vascular changes in acute inflammation

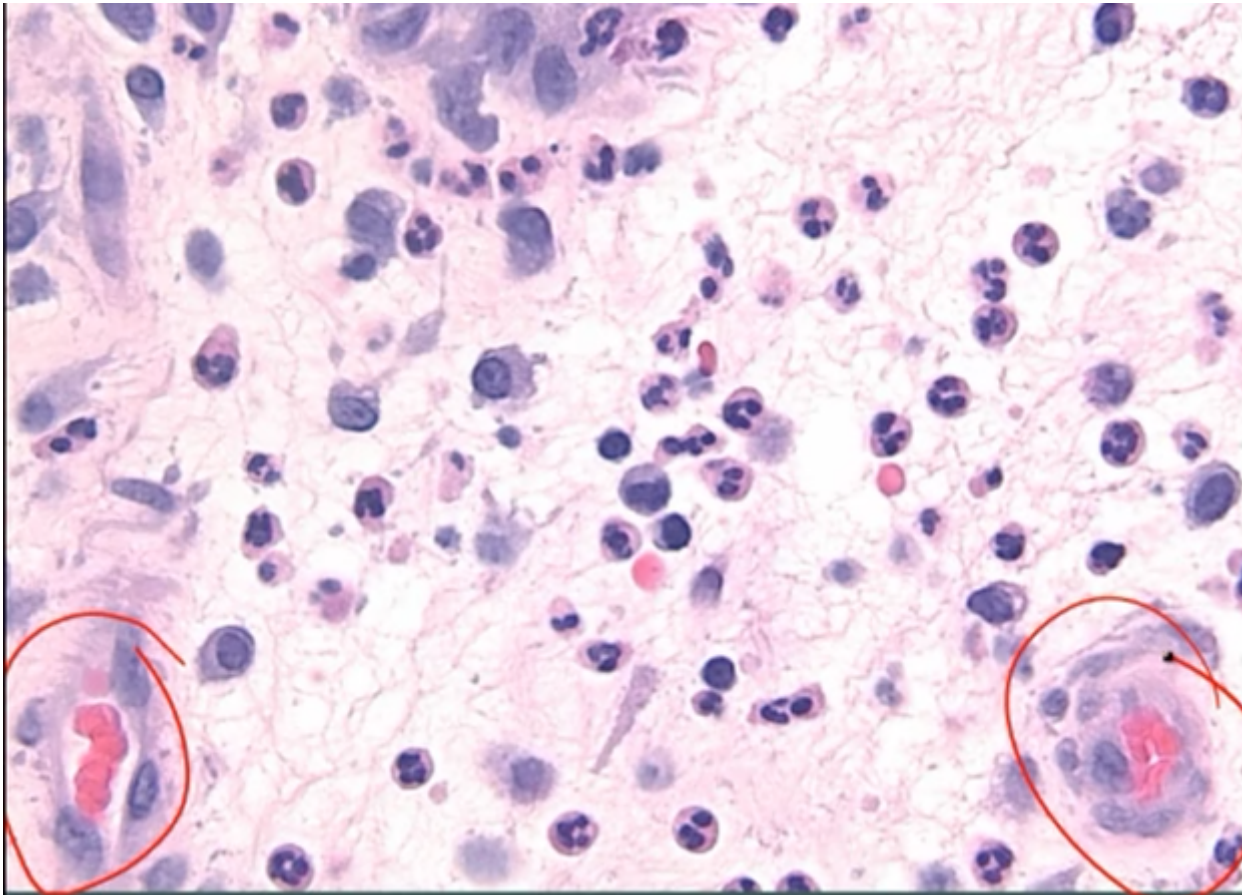
Sequence of vascular events in acute inflammation:

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



5. Describe the sequence of vascular changes in acute inflammation

1. Hemodynamic changes



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

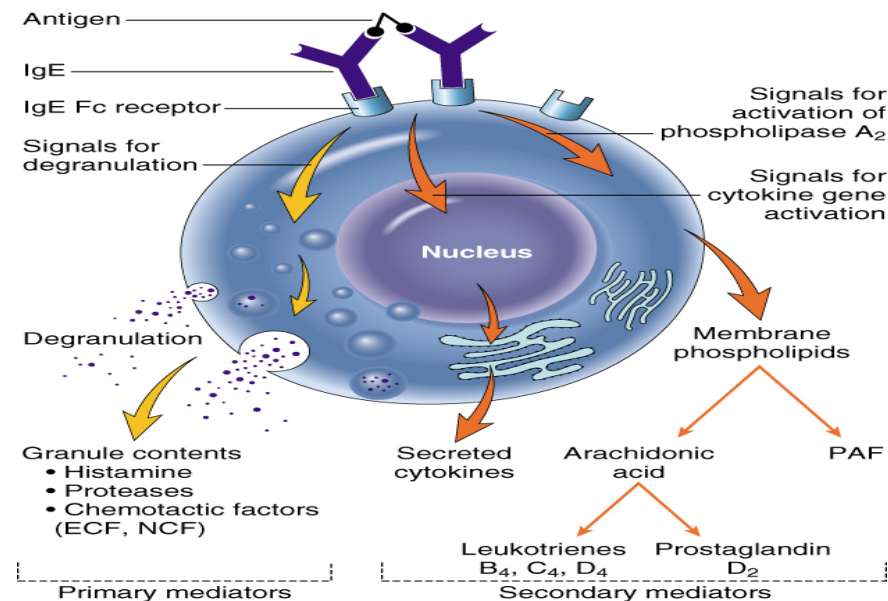
1. Transient vasoconstriction of arterioles

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

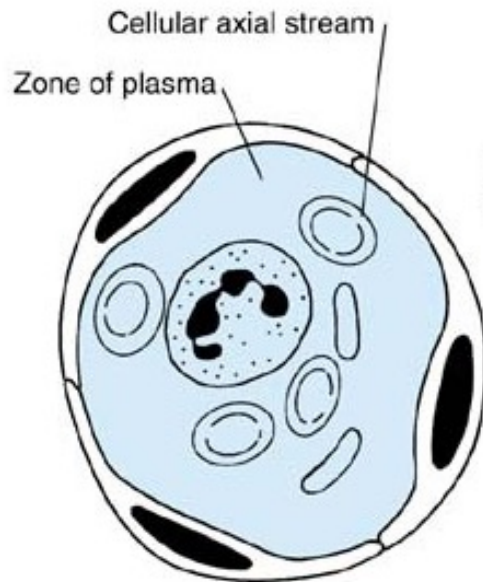
Phases of changes in Vascular Caliber and Flow

3. Slowing of the circulation

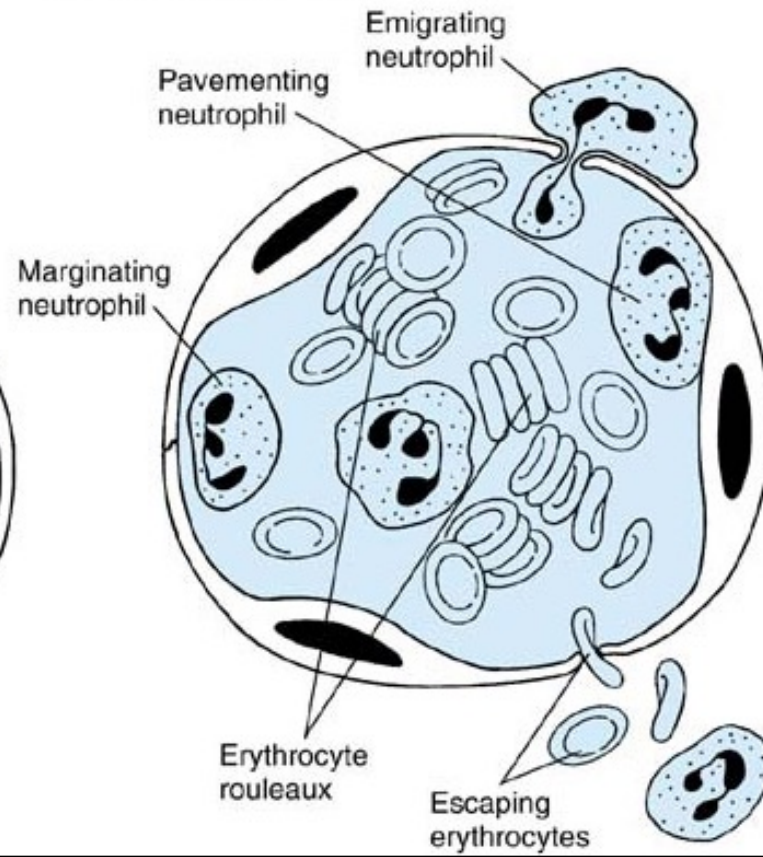
due to increased permeability of the microvasculature, this leads to outpouring of protein-rich fluid in the extravascular tissues.

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

A Normal postcapillary venule



B Acute inflammation



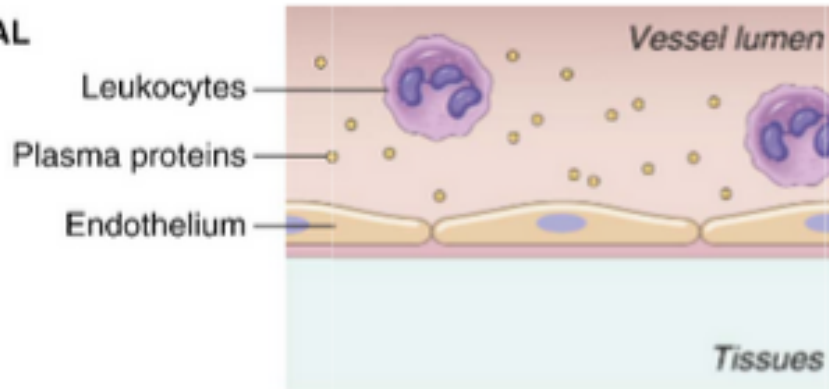
Vascular Events

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

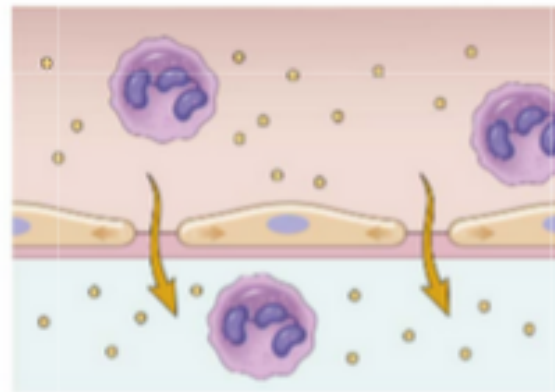
5. Describe the sequence of vascular changes in acute inflammation

A. NORMAL



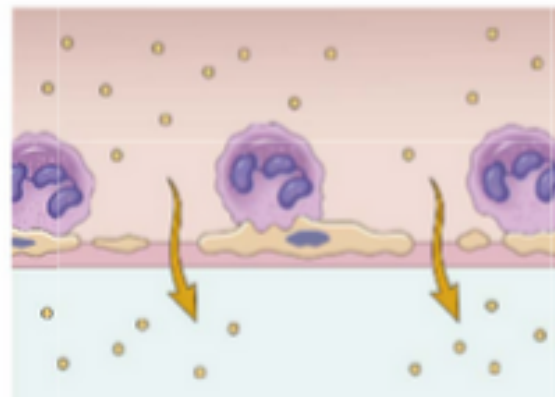
B. RETRACTION OF ENDOTHELIAL CELLS

- Induced by histamine, other mediators
- Rapid and short-lived (minutes)



C. ENDOTHELIAL INJURY

- Caused by burns, some microbial toxins
- Rapid; may be long-lived (hours to days)



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

venules

Arterioles, capillaries and venules

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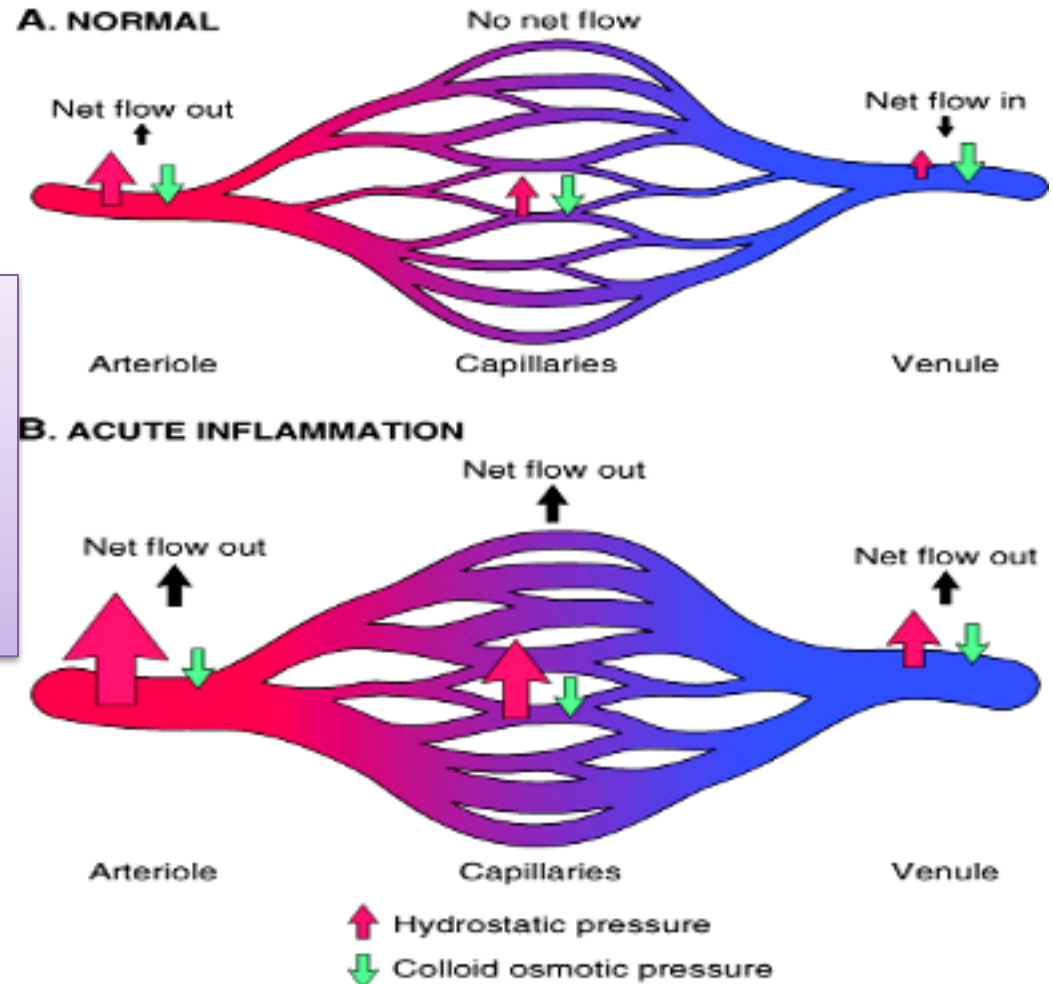
7. Compare normal capillary exchanges with exchange during inflammatory response

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

What is the edema?

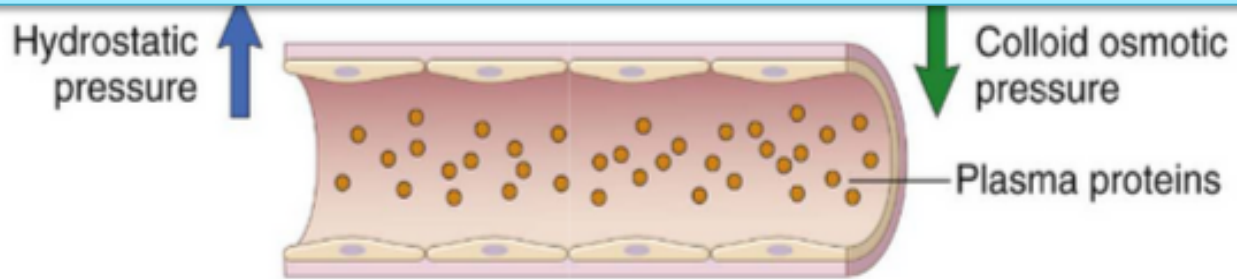
denotes an excess of fluid in the interstitial or serous cavities

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



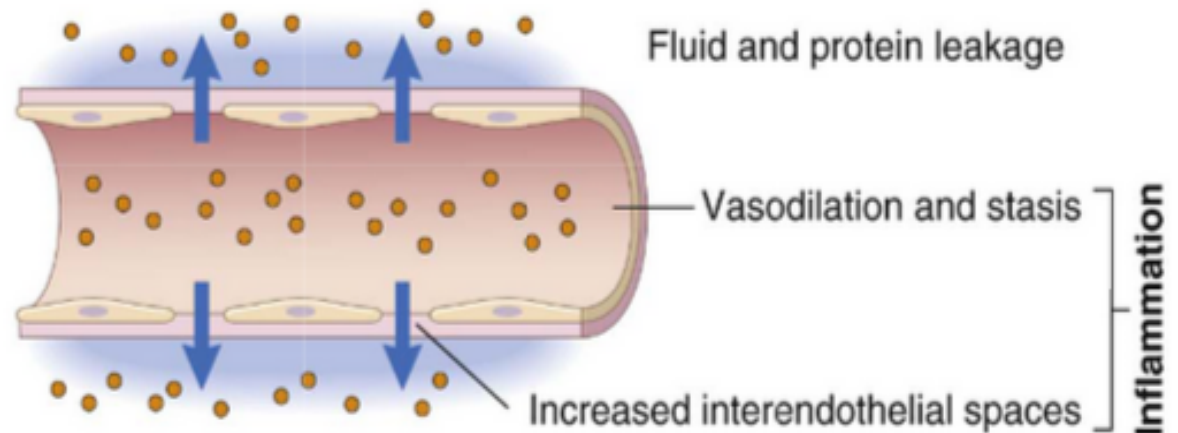
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A. NORMAL



B. EXUDATE

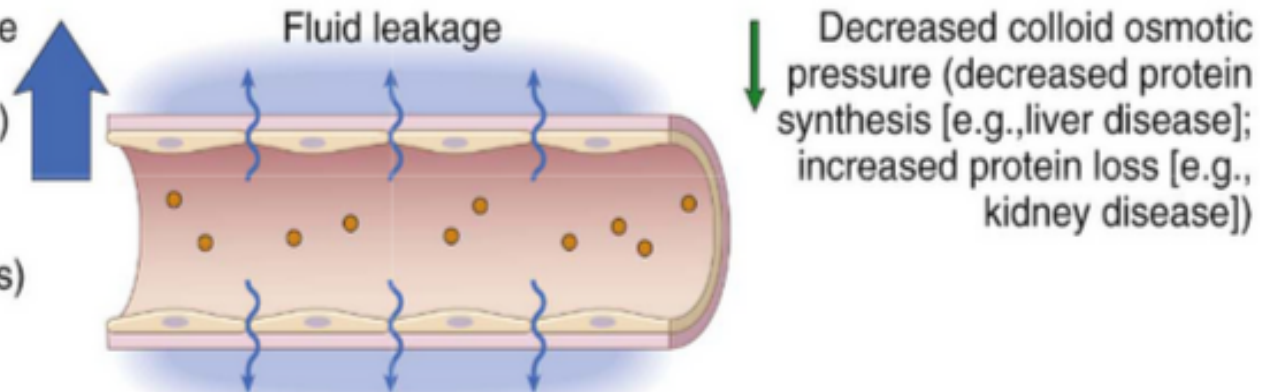
(high protein content, and may contain some white and red cells)



C. TRANSUDATE

(low protein content, few cells)

Increased hydrostatic pressure (venous outflow obstruction, [e.g., congestive heart failure])



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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.

