

INFLAMMATION AND REPAIR

Lecture 1

Definition of inflammation; Acute Inflammation
Vascular Events in Inflammation

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Foundation Block
Pathology
2017

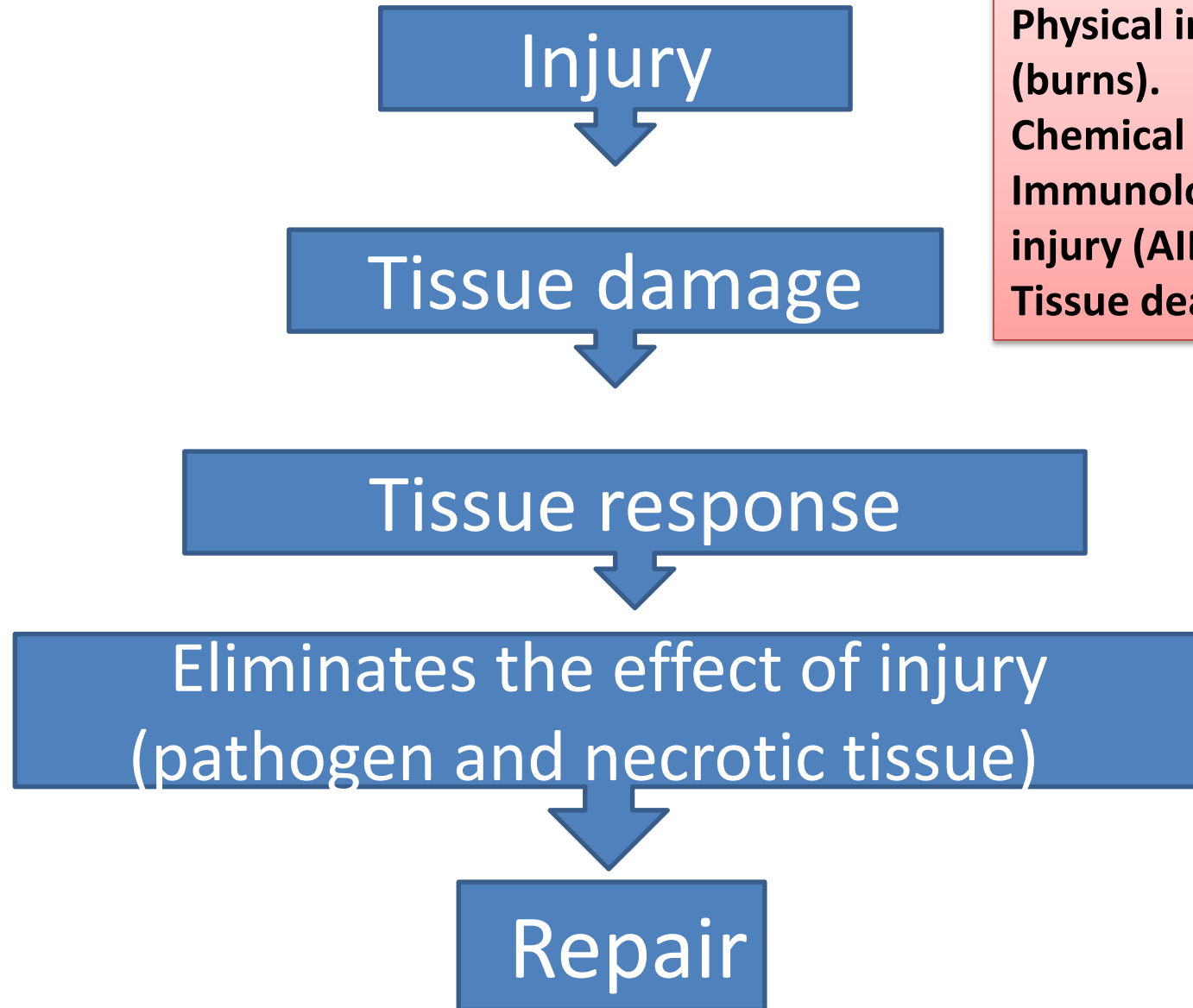
Learning Objectives:

- 1. Define inflammation.**
- 2. List cells & molecules that play important roles in inflammation**
- 3. Compare between 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. Know the mechanisms of increased vascular permeability.**
- 7. Compare normal capillary exchanges with exchange during inflammatory response.**
- 8. Define the terms edema, transudate, and exudate.**

Reference book and the relevant page numbers..

- Robbins Basic Pathology 9th edition
- Page: 29 - 34

1. Define inflammation.



Infection.
Trauma.
Physical injury (burns).
Chemical injury.
Immunological injury (AID).
Tissue death (MI).

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 agent, limit tissue injury and restore tissue to normality

➔ Therefore, Inflammation is part of a broader protective response (*innate immunity*)

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

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.

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.

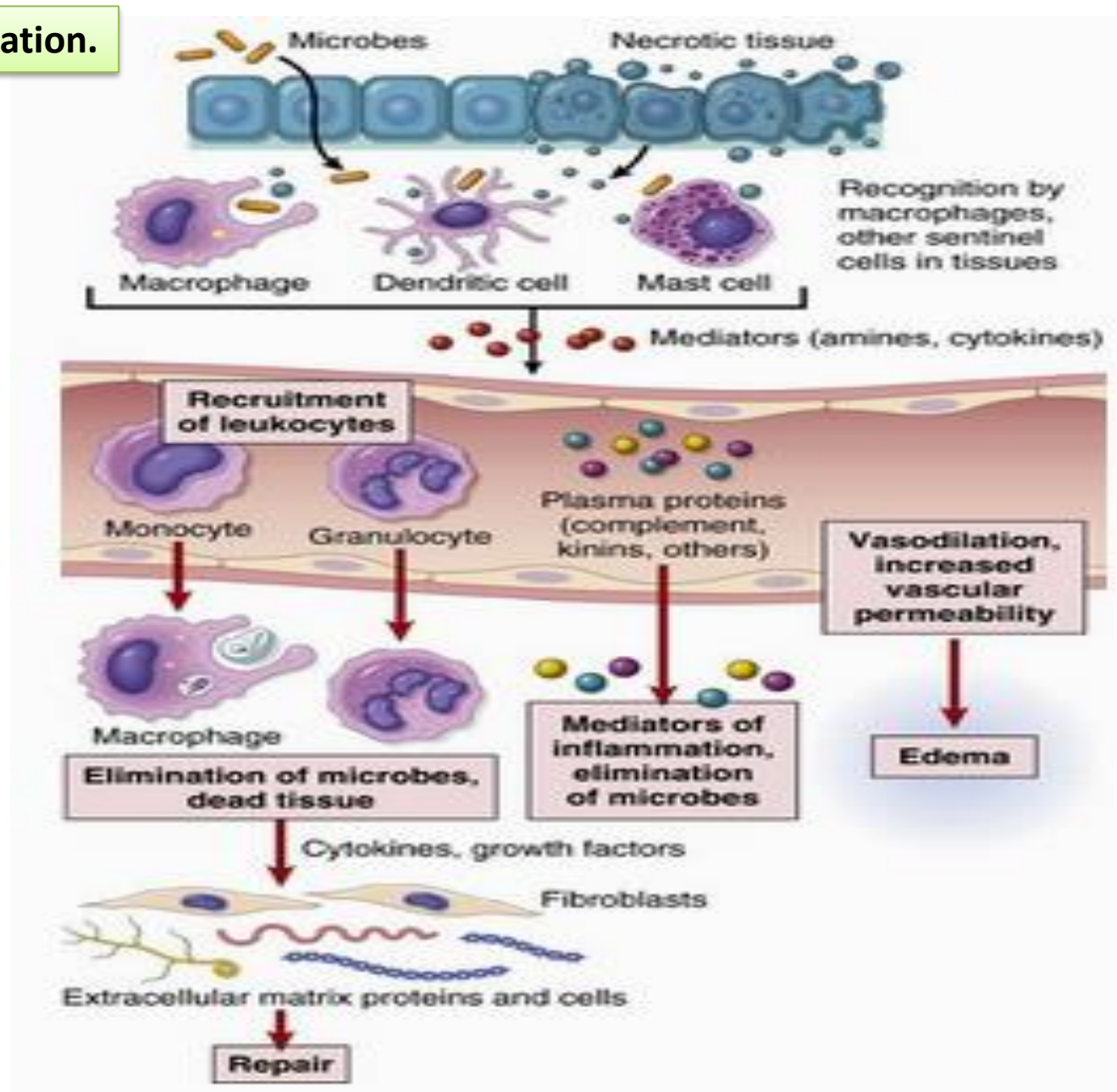


The reaction is controlled and terminated.



The damaged tissue is repaired.

1. Define inflammation.



Can inflammation be harmful ! ?

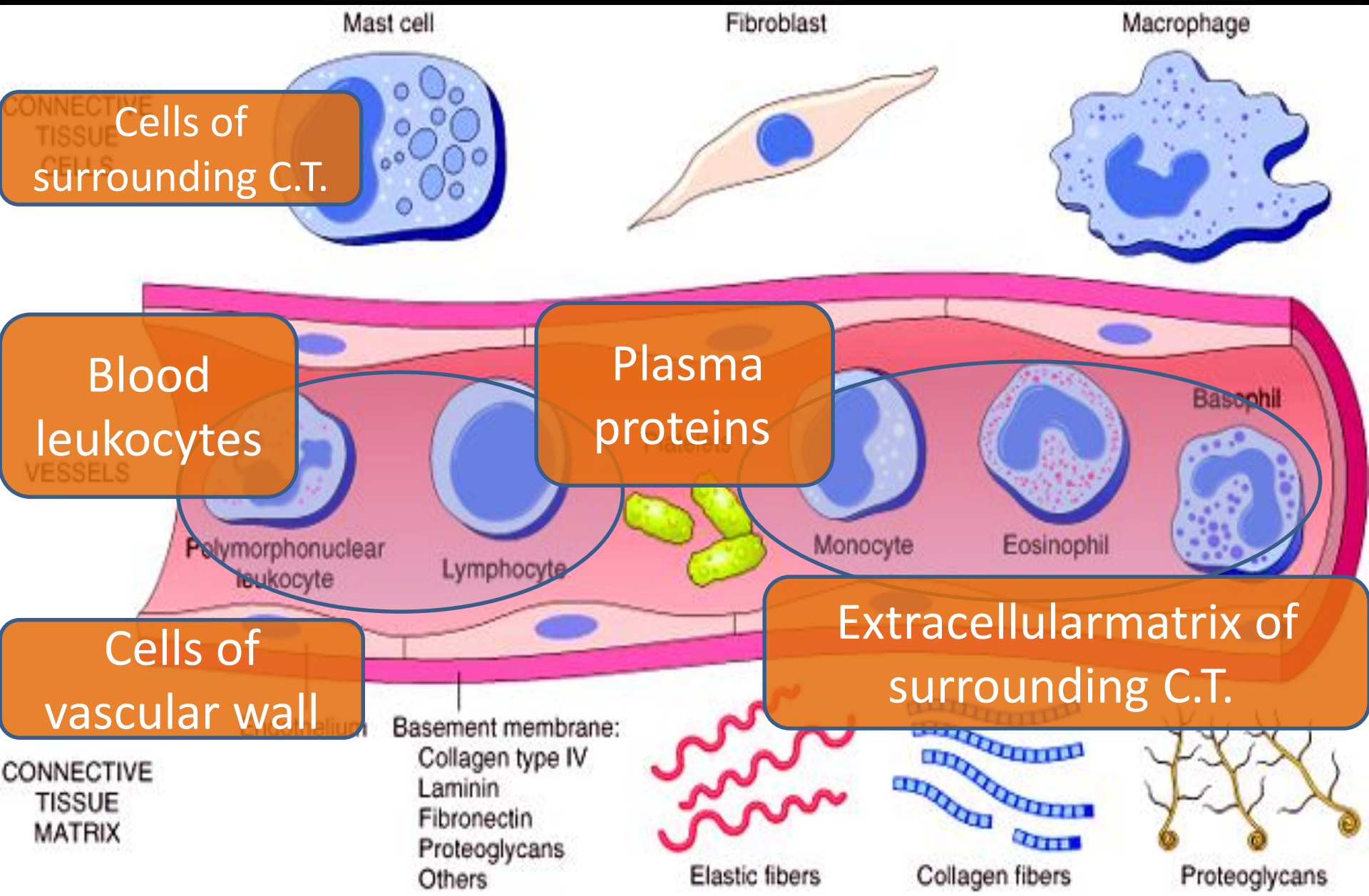
- Inflammation can induce harm:
e.g. anaphylactic reaction
rheumatoid arthritis
atherosclerosis

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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

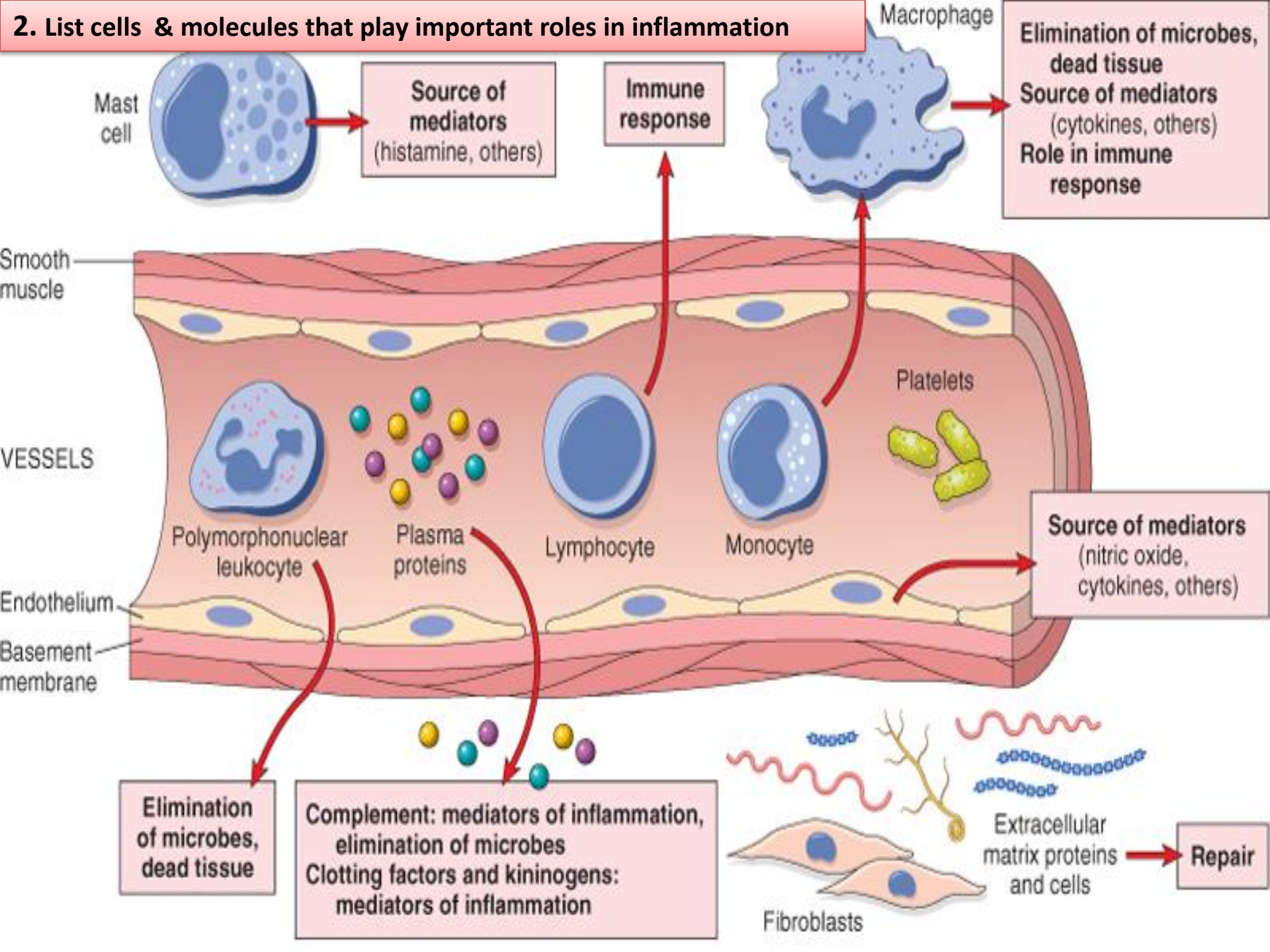
Leukocyte

Endothelium

Mast cell

2. Plasma proteins

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



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- 3. Compare between the two types of inflammation**
4. Recognize the cardinal signs of 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 (red, hot, edematous, pain) & systemic signs (fever, increased C reactive protein, raised ESR...)		

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

Rubor :- redness

Calor: – warmth

Dolor :- pain

Functio Laesa :-
loss of function

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 small blood vessels 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)

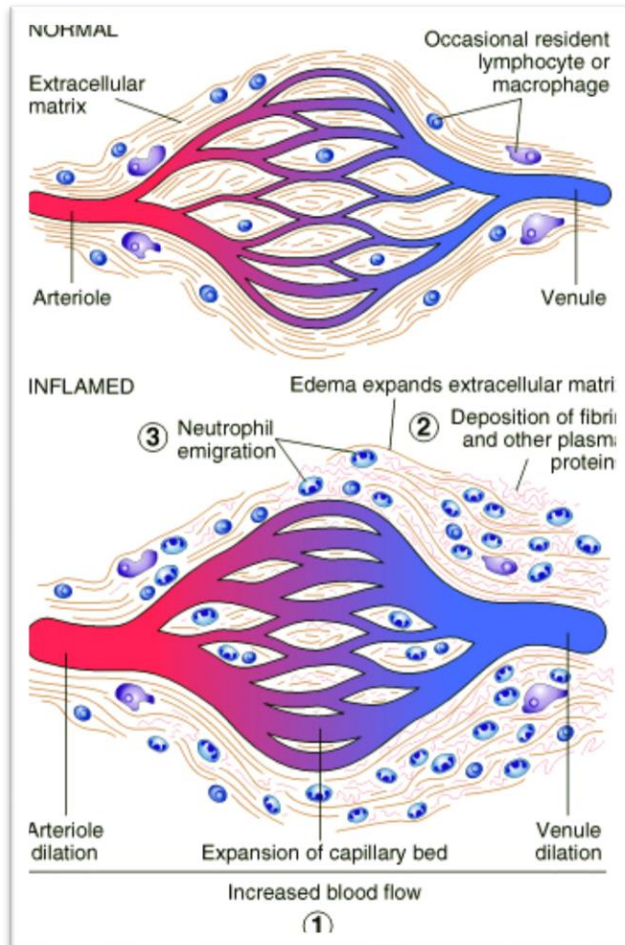
vascular

cellular

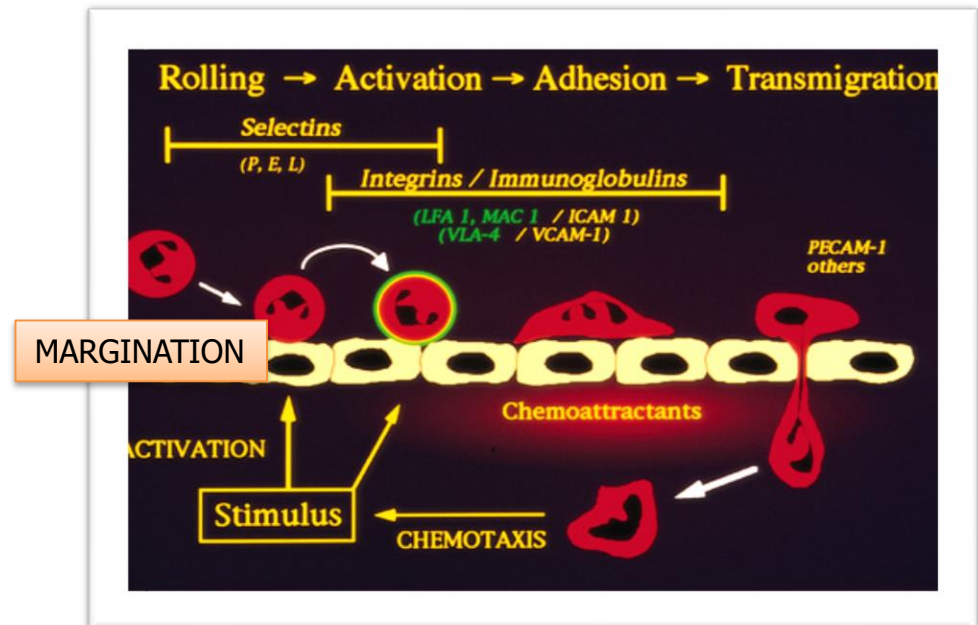
5. Describe the sequence of vascular changes in acute inflammation

Events of acute Inflammation

Vascular Events



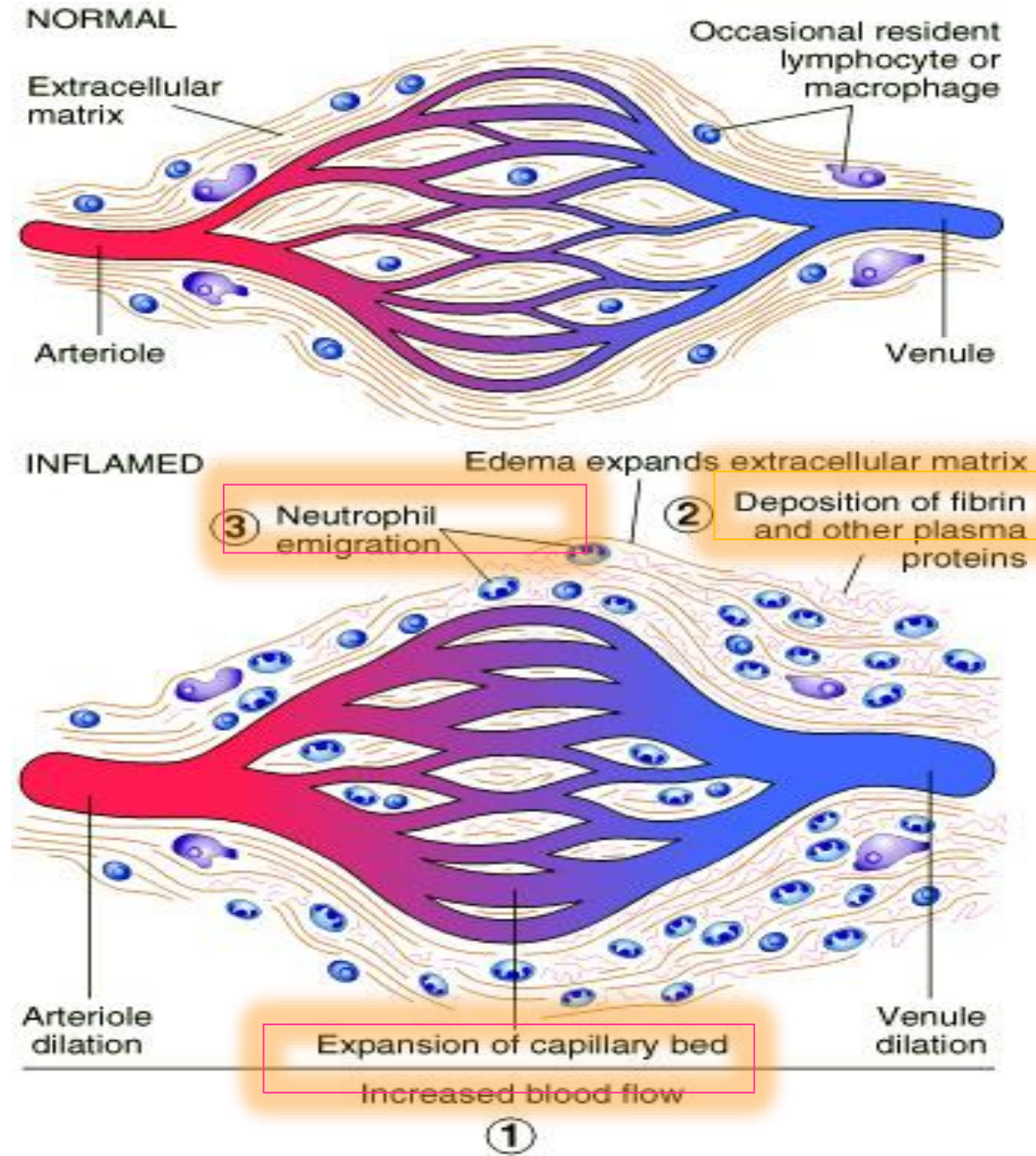
Cellular Events



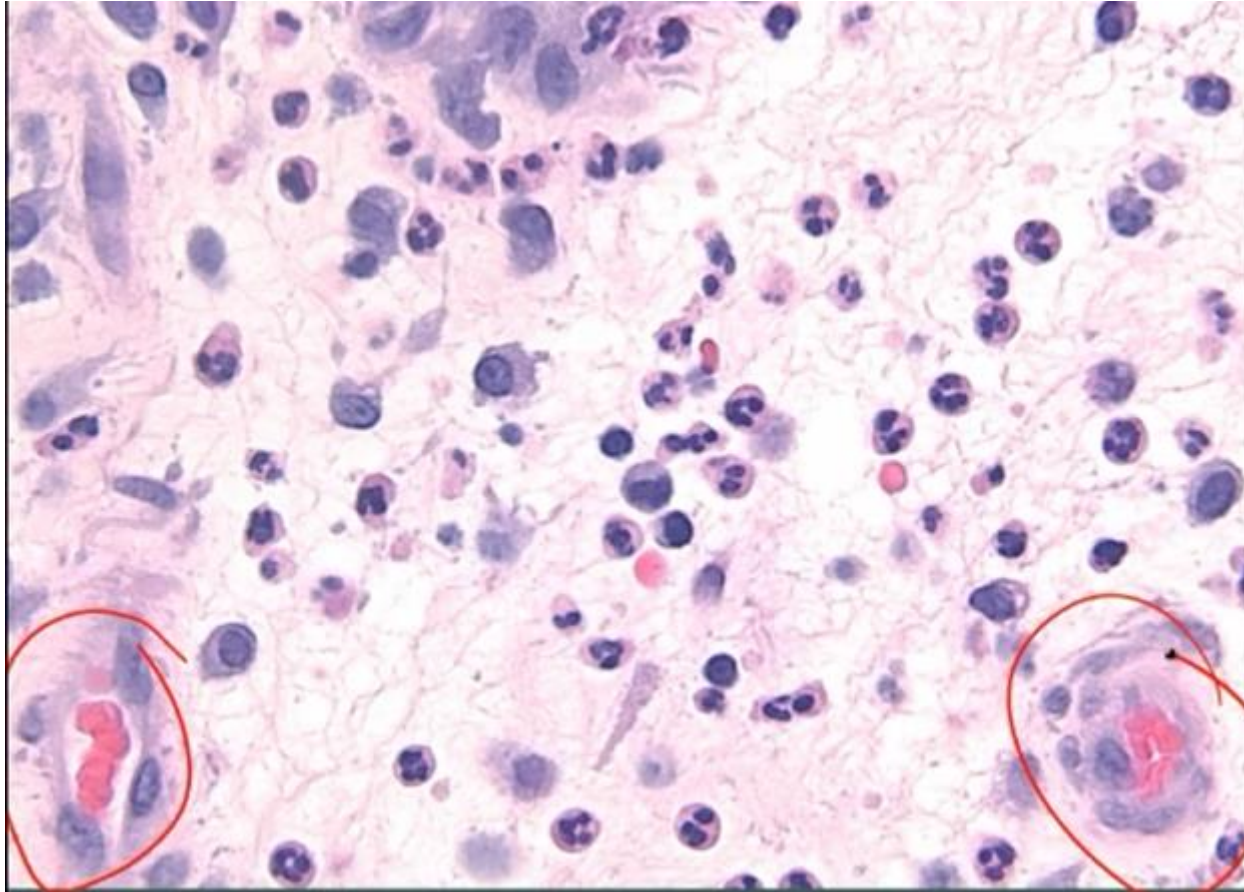
5. Describe the sequence of vascular changes in acute inflammation

Vascular Events

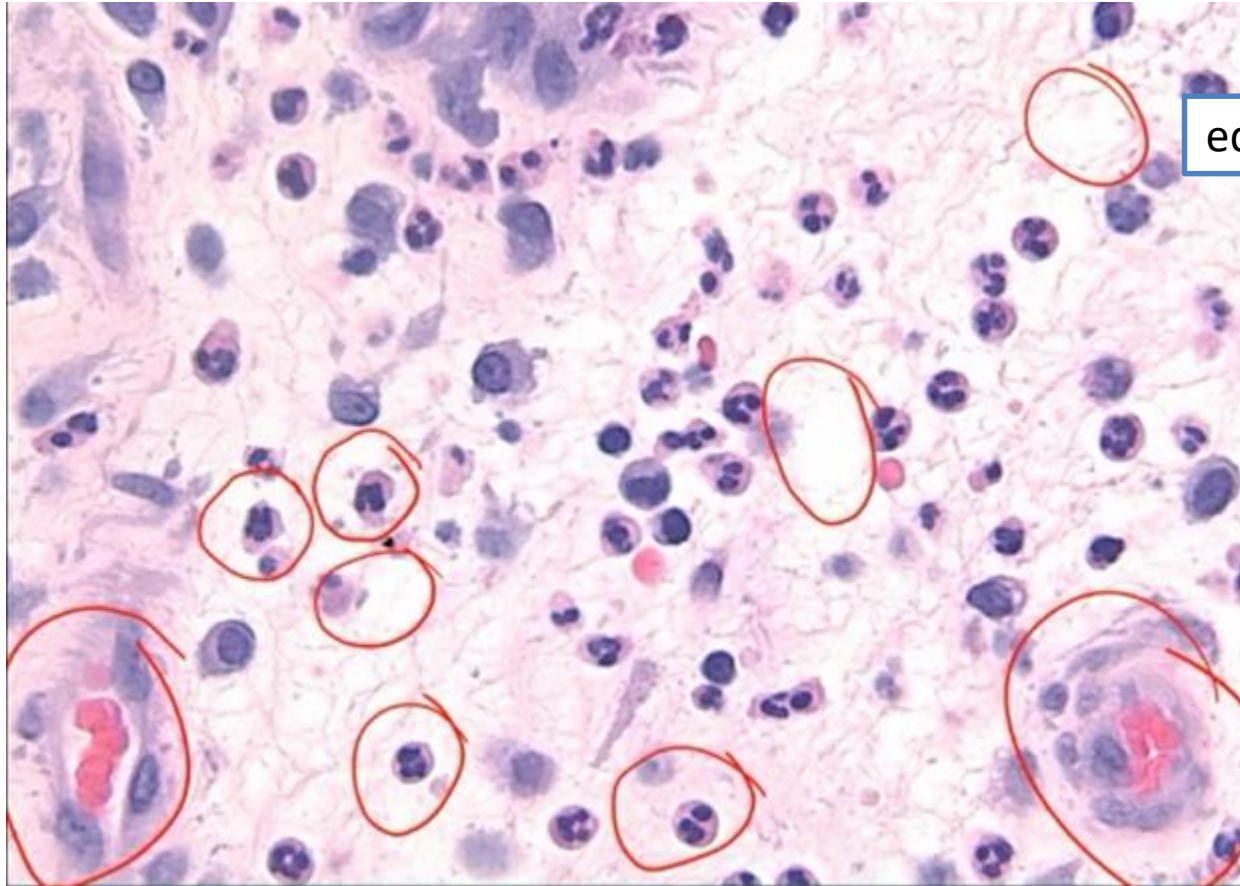
1. Vasodilatation Hemodynamic changes



5. Describe the sequence of vascular changes in acute inflammation



5. Describe the sequence of vascular changes in acute inflammation



edema

5. Describe the sequence of vascular changes in acute inflammation

Phases of changes in Vascular Caliber and Flow

1. Transient vasoconstriction of arterioles

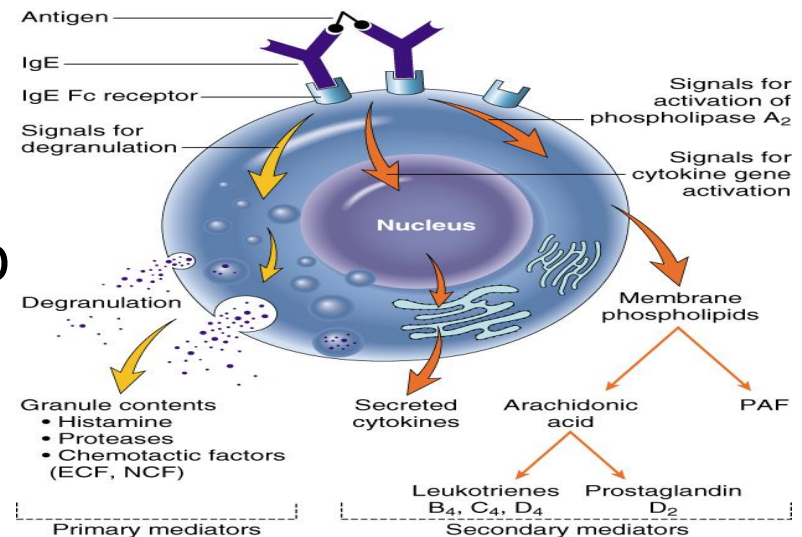
It disappears within 3-5 seconds in mild injuries

2. **Vasodilatation:** It involves the **arterioles** results in opening of new microvasculature beds in the area leading to increasing blood flow – Histamine effect

3. Slowing of the circulation

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

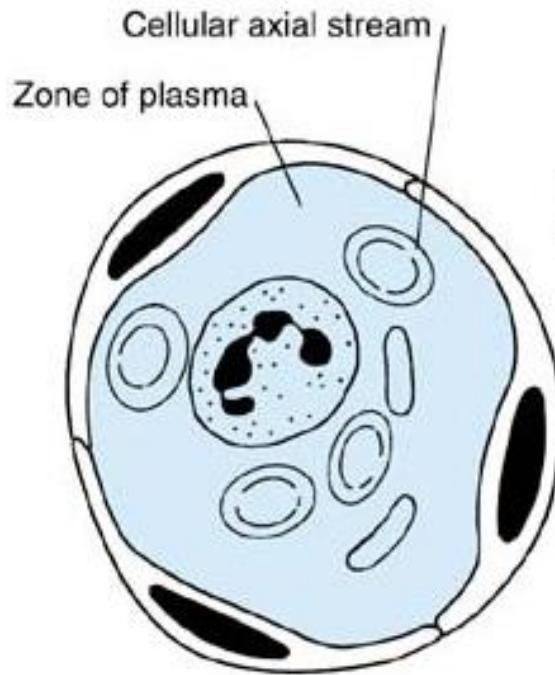
4. **Stasis:** slow circulation due to dilated small vessels packed with red cells



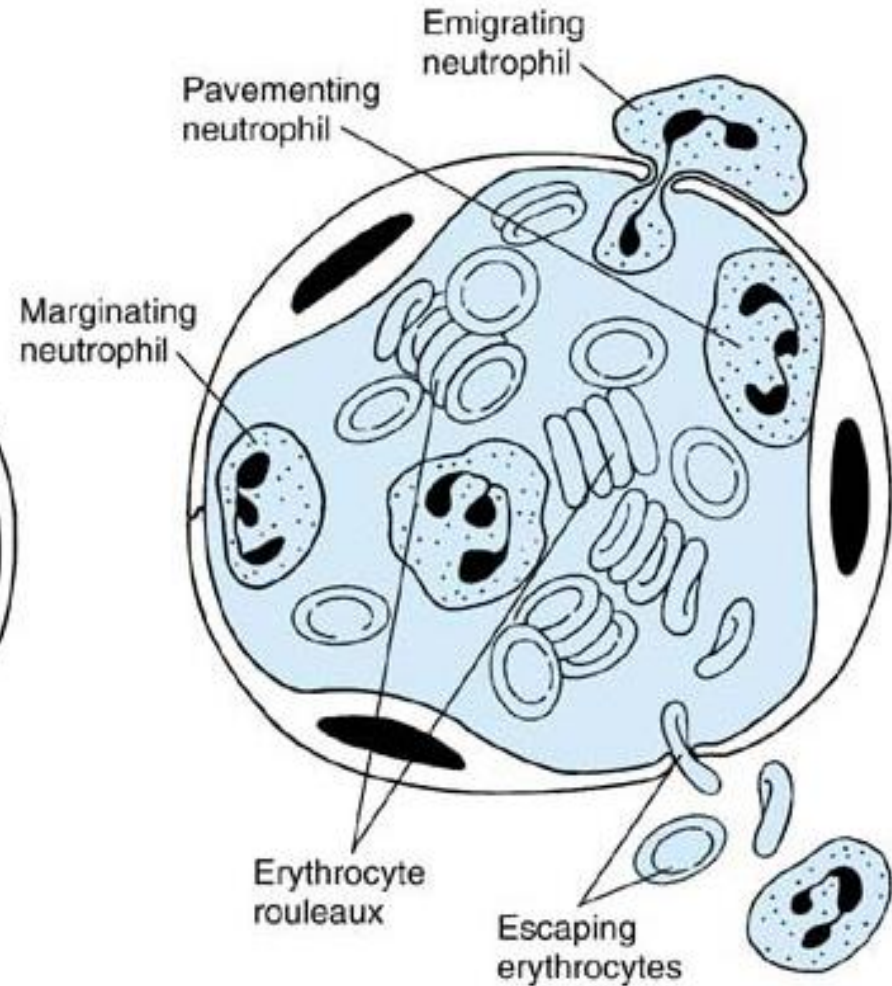
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Slowing of the circulation

A Normal postcapillary venule



B Acute inflammation



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Vascular Events

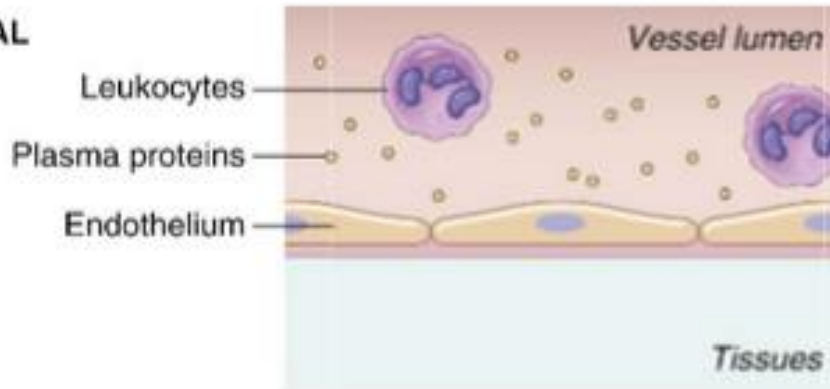
2. Increased Vascular Permeability

- 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

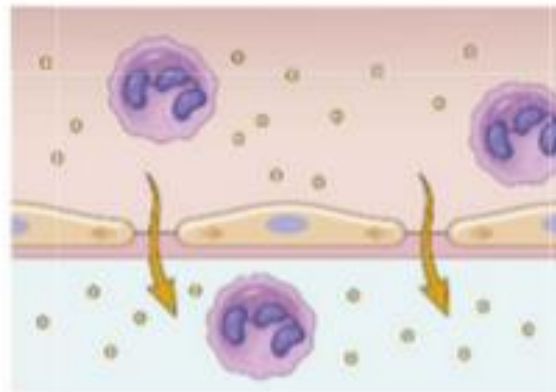
6. Know the mechanisms of increased vascular permeability

A. NORMAL



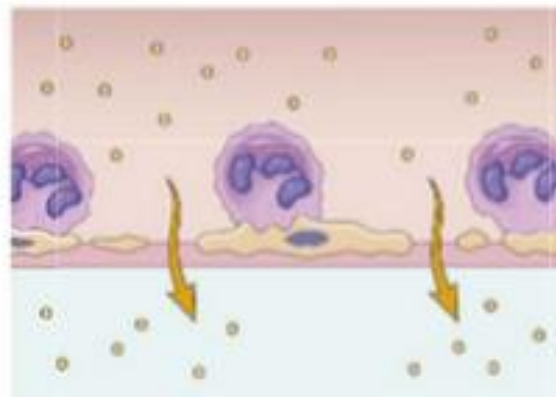
B. RETRACTION OF ENDOTHELIAL CELLS

- 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

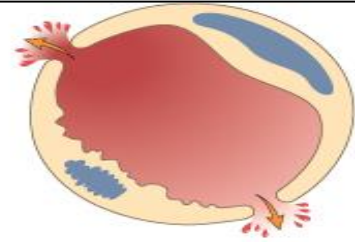
Arterioles, capillaries and venules

Mechanisms lead to increased vascular permeability

- *Endothelial cell contraction* 15-30 min
- *Endothelial injury*
 - *immediate sustained response* 6-24 hours
 - *delayed prolonged leakage* 12 hours- days
- *Leukocyte-mediated endothelial injury*
- *Transcytosis (occurs via channels formed by fusion of intracellular vesicles)*
- *Leakage from new blood vessels*

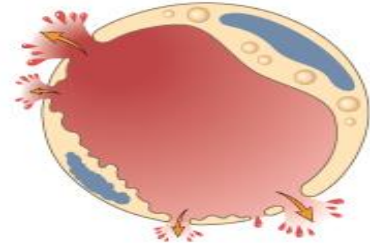
Gaps due to endothelial contraction

- Venules
- Vasoactive mediators (histamine, leukotrienes, etc.)
- Most common
- Fast and short-lived (minutes)



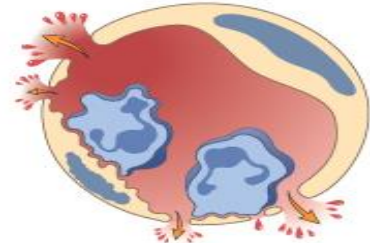
Direct injury

- Arterioles, capillaries, and venules
- Toxins, burns, chemicals
- Fast and may be long-lived (hours to days)



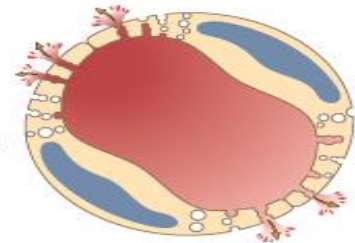
Leukocyte-dependent injury

- Mostly venules
- Pulmonary capillaries
- Late response
- Long-lived (hours)



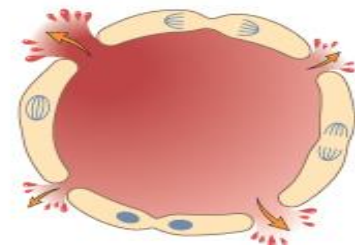
Increased transcytosis

- Venules
- Vascular endothelium-derived growth factor



New blood vessel formation

- Sites of angiogenesis
- Persists until intercellular junctions form



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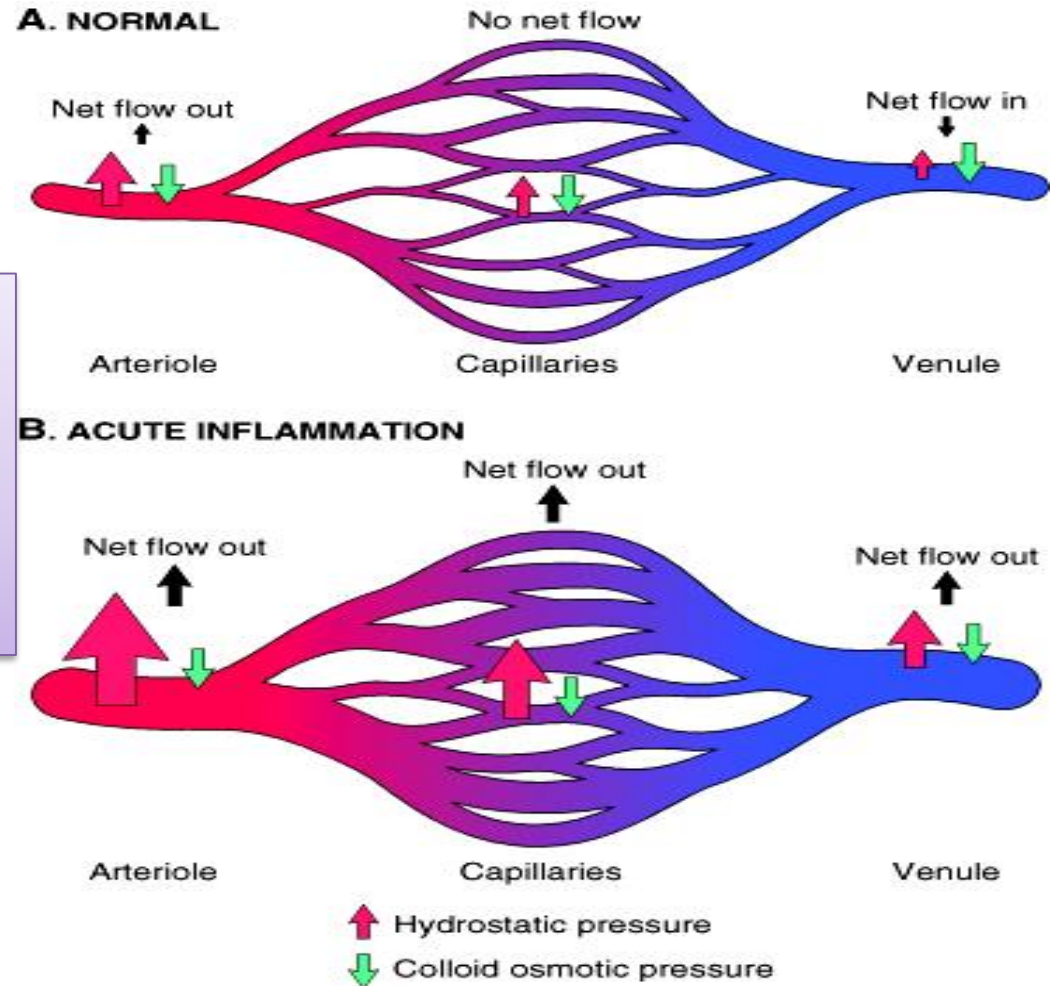
7. Compare normal capillary exchanges with exchange during inflammatory response

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

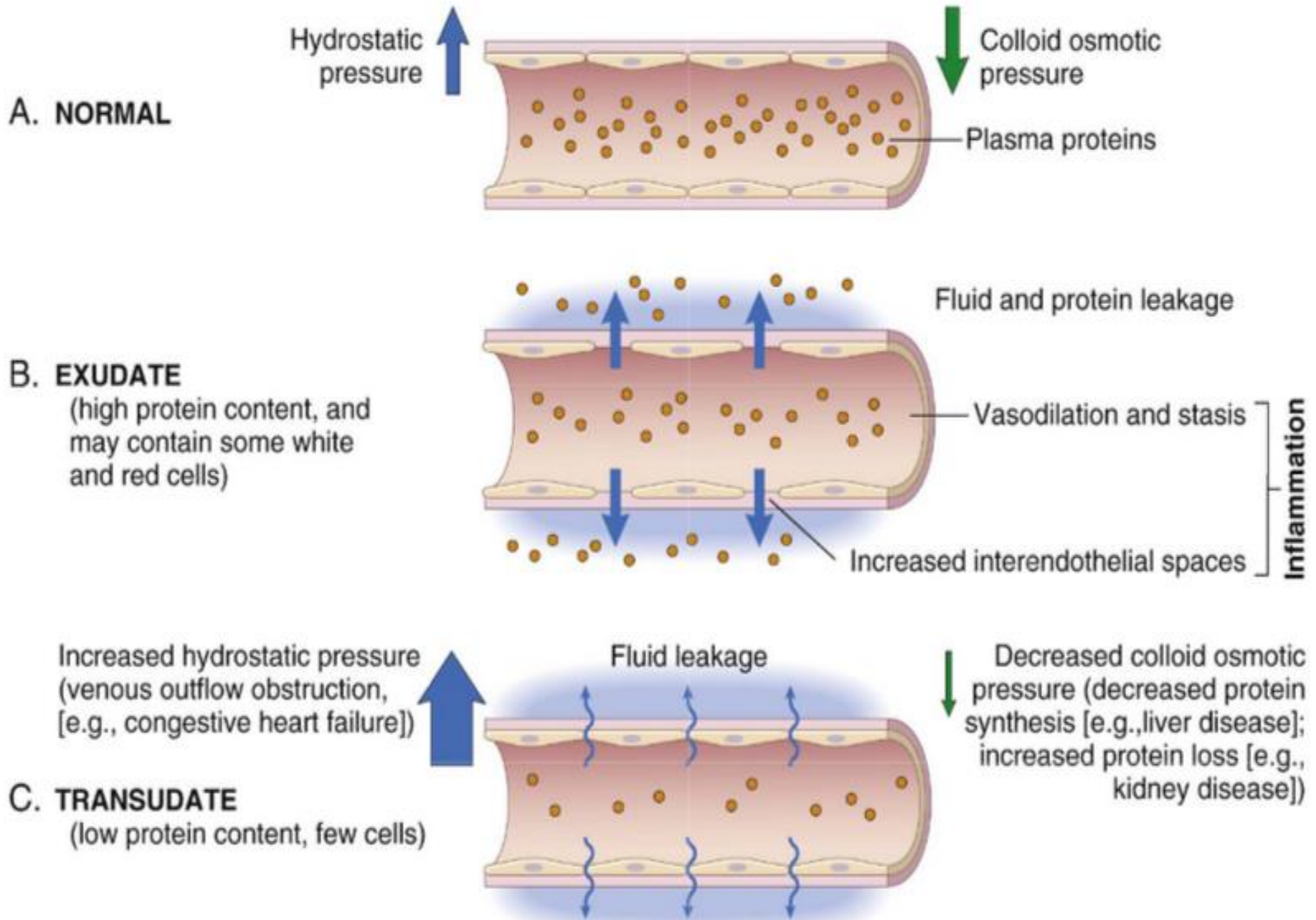
What is the edema?

denotes an excess of fluid in the interstitial or serous cavities

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



7. Compare normal capillary exchanges with exchange during inflammatory response



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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.

