Patofisiologi

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INFLAMASI

Inflamasi

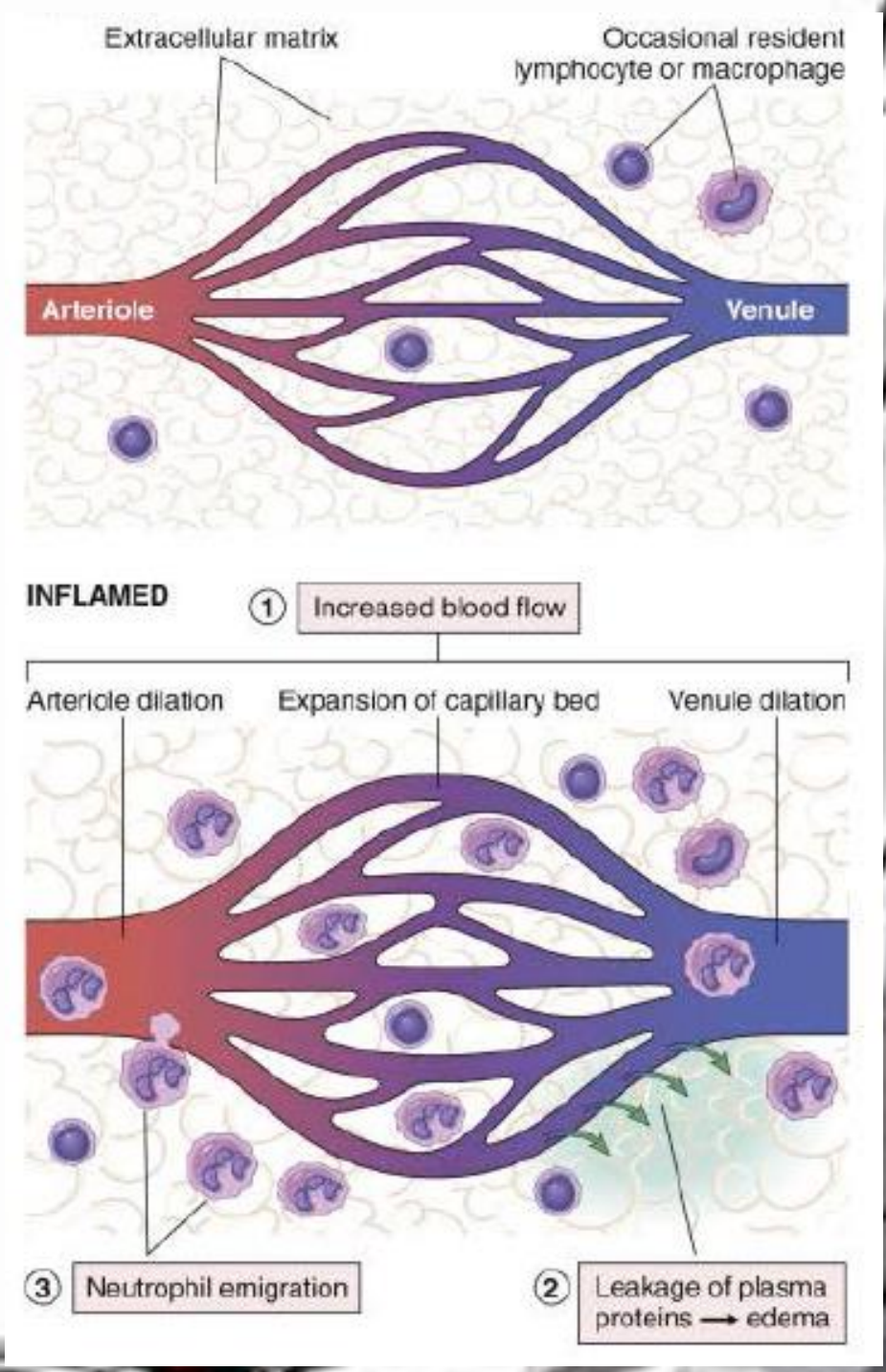
- Merupakan respons cepat terhadap jejas pada jaringan hidup yang memiliki vaskularisasi dengan mengirimkan mediator pertahanan tubuh (leukosit dan protein plasma) ke lokasi jejas
- Penyebab:
  - infeksi mikroba
  - agen fisik
  - zat kimia
  - jaringan nekrotik
  - interaksi imun.

- Tujuan:
  - mengisolasi jejas
  - menghancurkan mikroorganisme yang menginvasi tubuh serta menghilangkan aktivitas toksinnya
  - Menghilangkan sel/jaringan nekrosis
  - mempersiapkan jaringan bagi kesembuhan serta perbaikan.

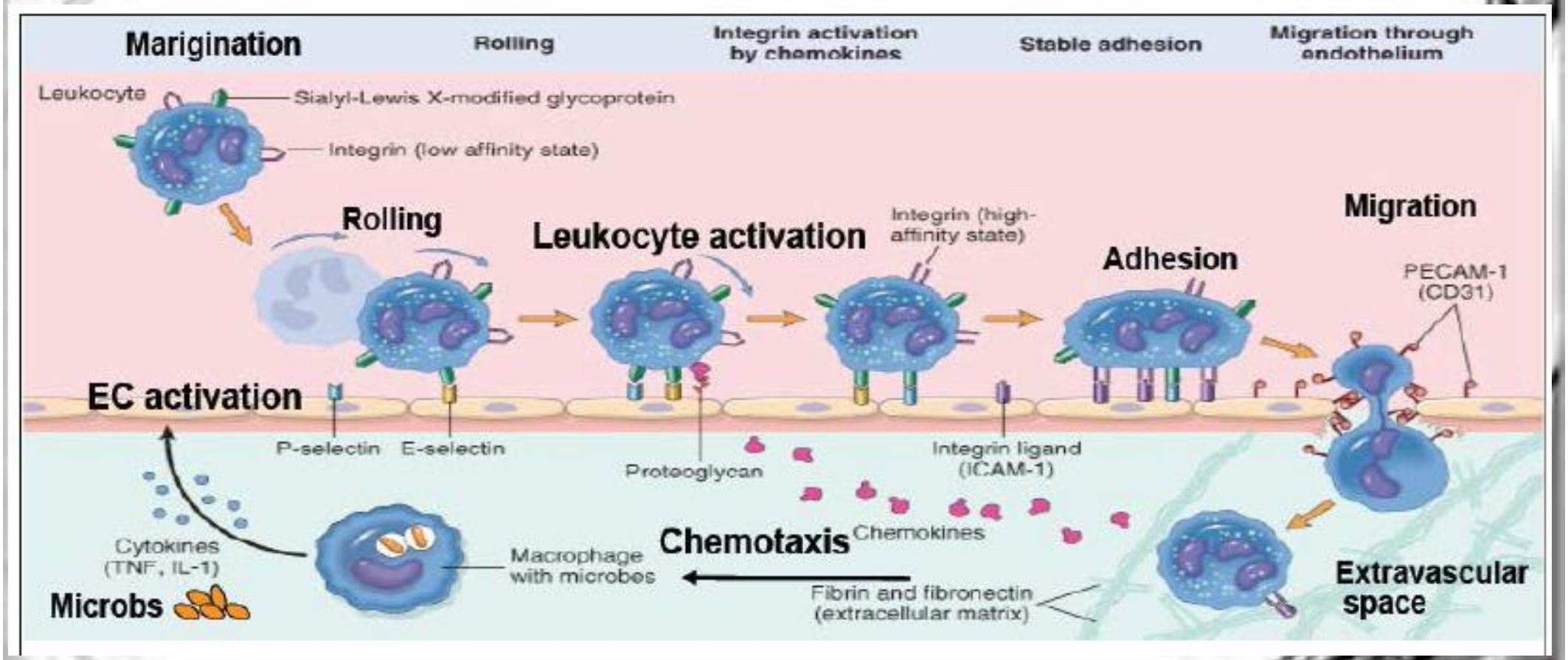
- Tanda:
  - Panas (calor)
  - Kemerahan (rubor)
  - Edema (tumor)
  - Nyeri (dolor)
  - Kehilangan fungsi jaringan terkait

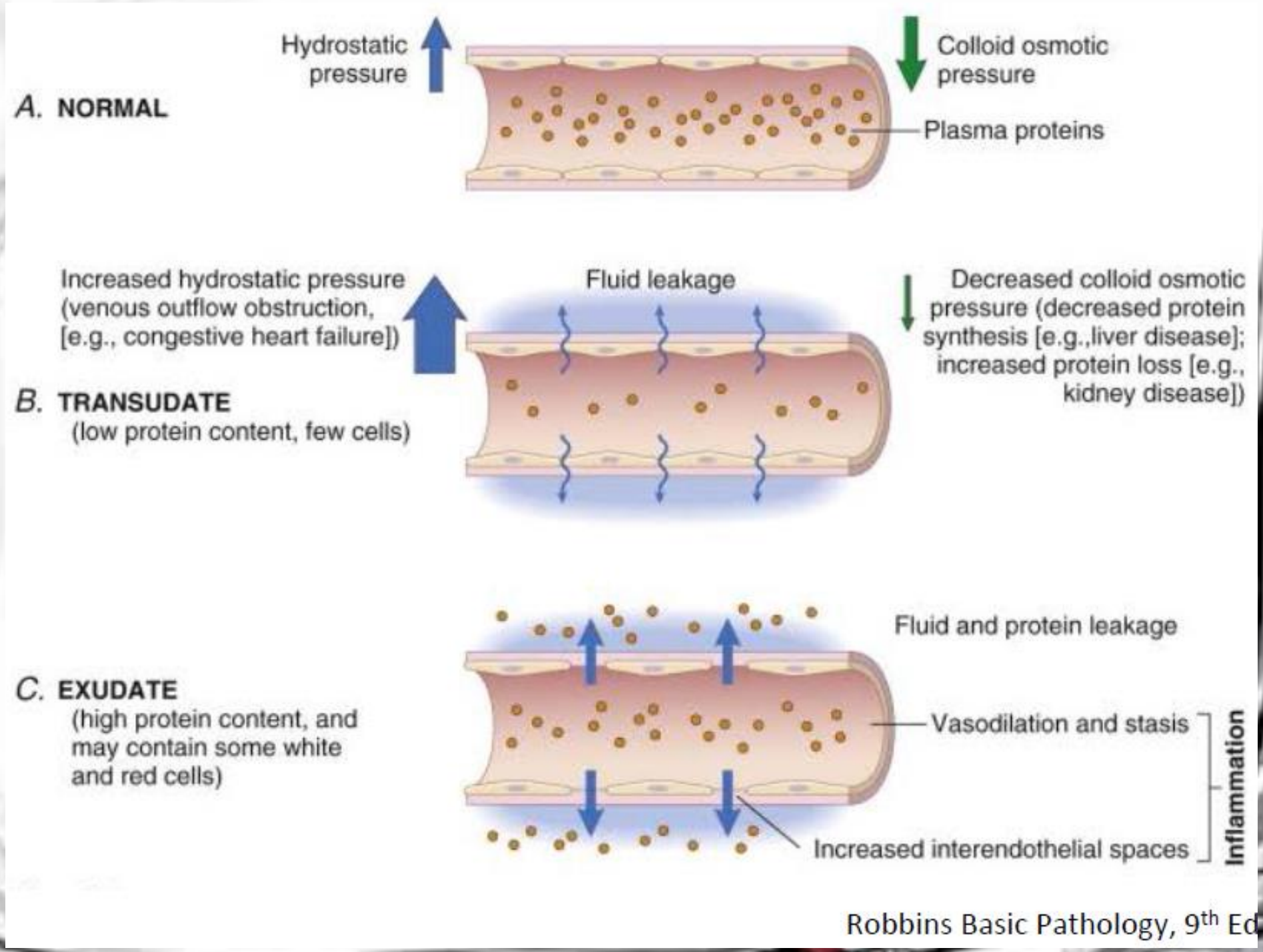
Mekanisme Inflamasi

1. Respon awal mencakup pelepasan mediator dari sel dan plasma
2. Peningkatan aliran darah dan permeabilitas kapiler di daerah jejas → pergerakan cairan dan protein plasma ke ruang ekstraseluler jaringan
3. Migrasi dan aktivasi leukosit sebagai respon terhadap substansi antraktan



Migrasi Leukosit





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Acute inflammatory tissue injury

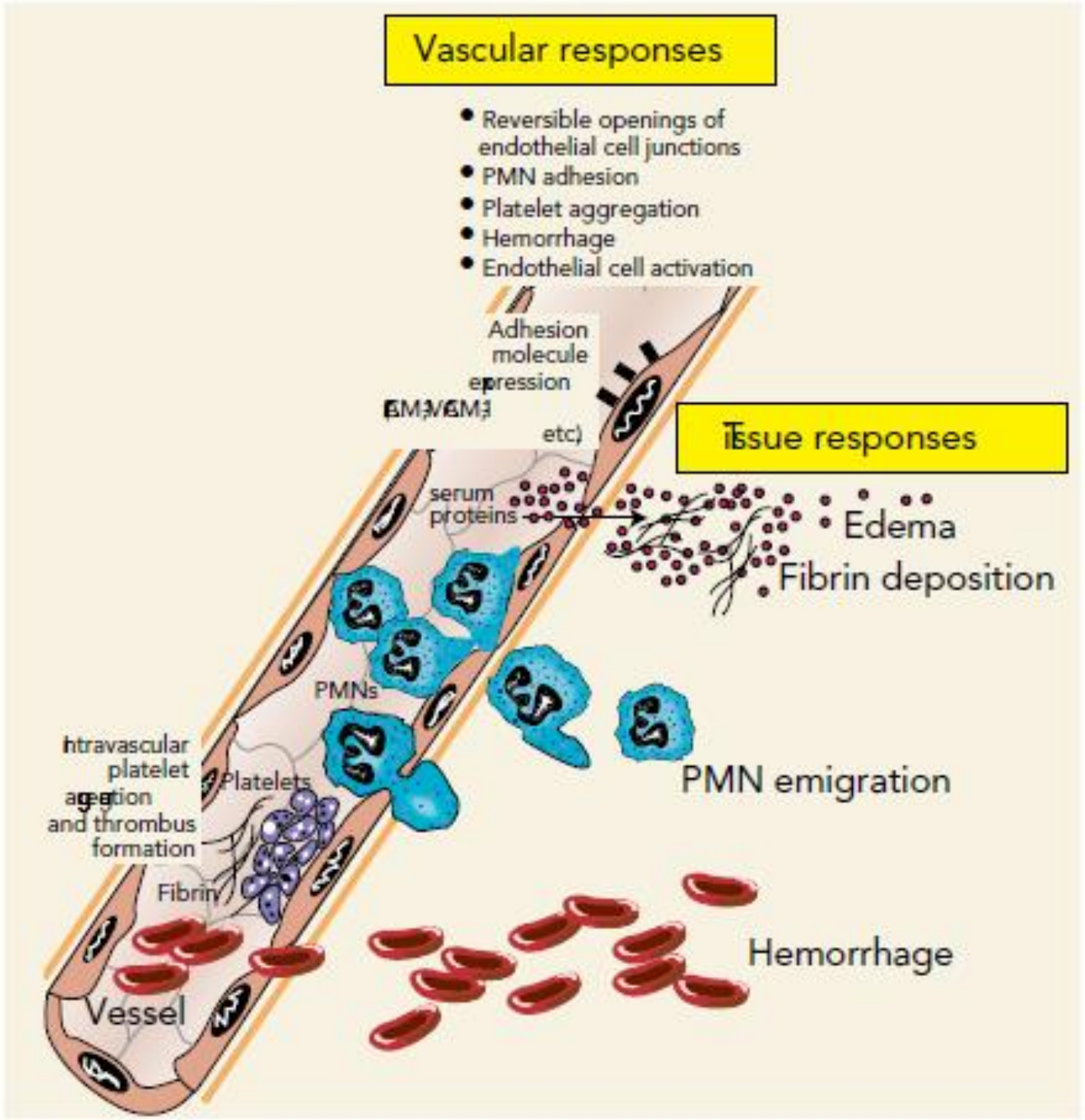
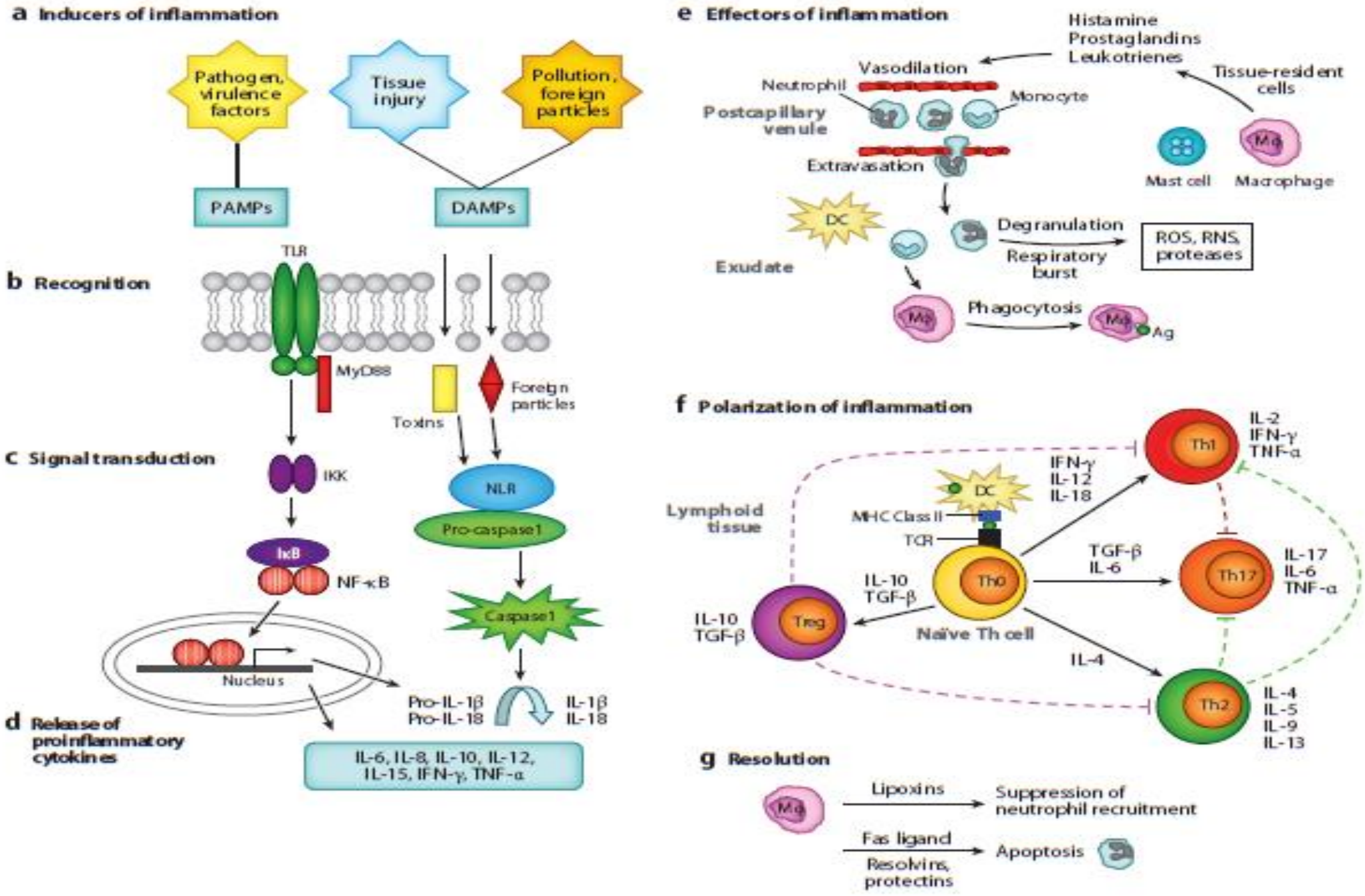
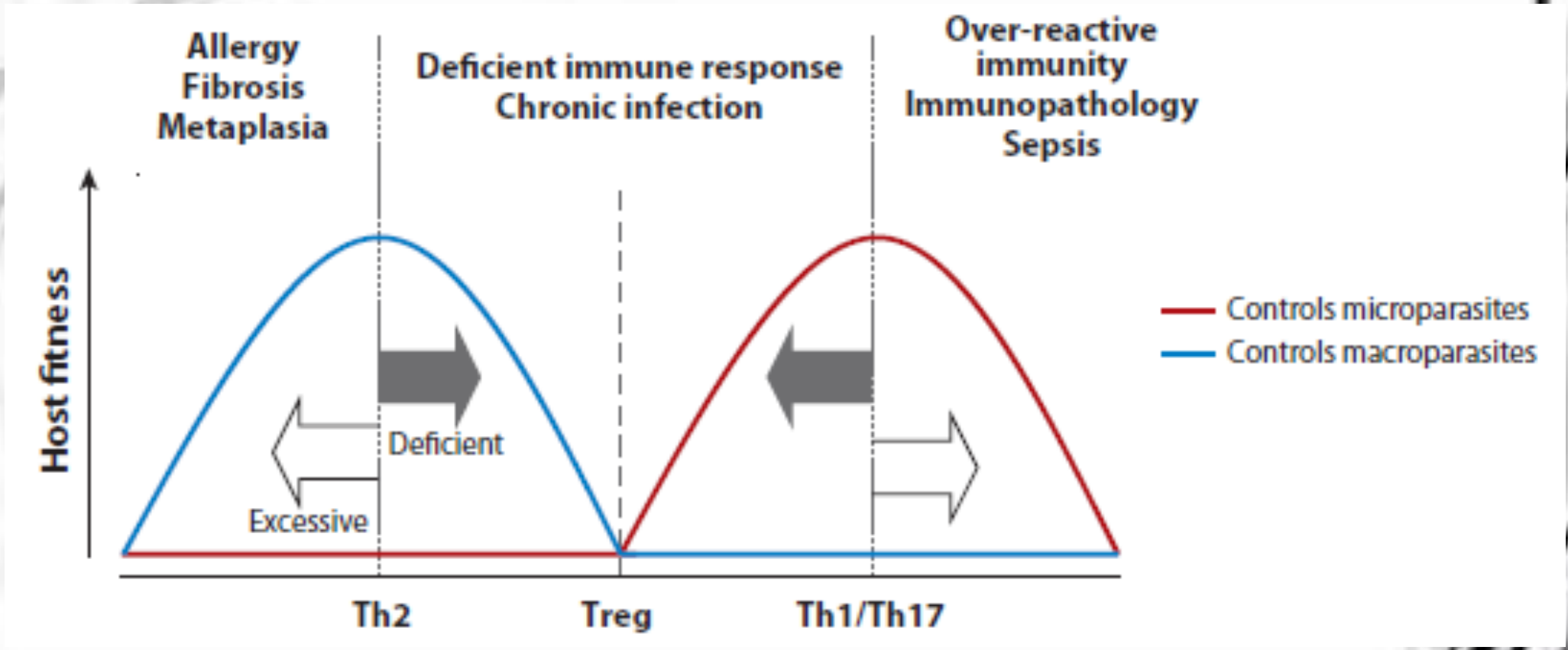


TABLE 1.1. Factors affecting vascular integrity

	Events	Factors responsible
Edema	Reversible opening of endothelial tight junctions	Histamine, serotonin, kinins (bradykinin), C3a, C5a, •NO, PAF, prostaglandins
PMN emigration	Movement beyond vascular barrier	Chemoattractants: C5a, cytokines (IL-1β, TNFα), CXC, chemokines: collagen and bacterial peptides, metabolites of arachidonic acid
Hemorrhage	RBCs in extravascular compartment	Physical forces (heat, cold), bacterial products, proteins and oxidants from phagocytes
Platelets	Intravascular aggregation and fibrin formation	PAF, ADP, thrombin activation, etc.


a Inducers of inflammation
Pathogen, virulence factors
Tissue injury
Pollution, foreign particles
PAMPs
DAMPs
b Recognition
TLR
MyD88
Toxins
Foreign particles
c Signal transduction
IKK
IκB
NF-κB
NLR
Pro-caspase1
Caspase1
Nucleus
d Release of proinflammatory cytokines
Pro-IL-1β
Pro-IL-18
IL-1β
IL-18
IL-6, IL-8, IL-10, IL-12, IL-15, IFN-γ, TNF-α
e Effectors of inflammation
Histamine
Prostaglandins
Leukotrienes
Vasodilation
Tissue-resident cells
Neutrophil
Monocyte
Postcapillary venule
Extravasation
Mast cell
Macrophage
DC
Degranulation
Respiratory burst
ROS, RNS, proteases
Exudate
Phagocytosis
Ag
f Polarization of inflammation
Th1
IL-2
IFN-γ
TNF-α
IFN-γ
IL-12
IL-18
DC
Lymphoid tissue
MHC Class II
TCR
Th0
TGF-β
IL-6
Th17
IL-17
IL-6
TNF-α
IL-10
TGF-β
Treg
IL-10
TGF-β
Naïve Th cell
IL-4
Th2
IL-4
IL-5
IL-9
IL-13
g Resolution
Lipoxins
Suppression of neutrophil recruitment
Fas ligand
Resolvins, protectins
Apoptosis

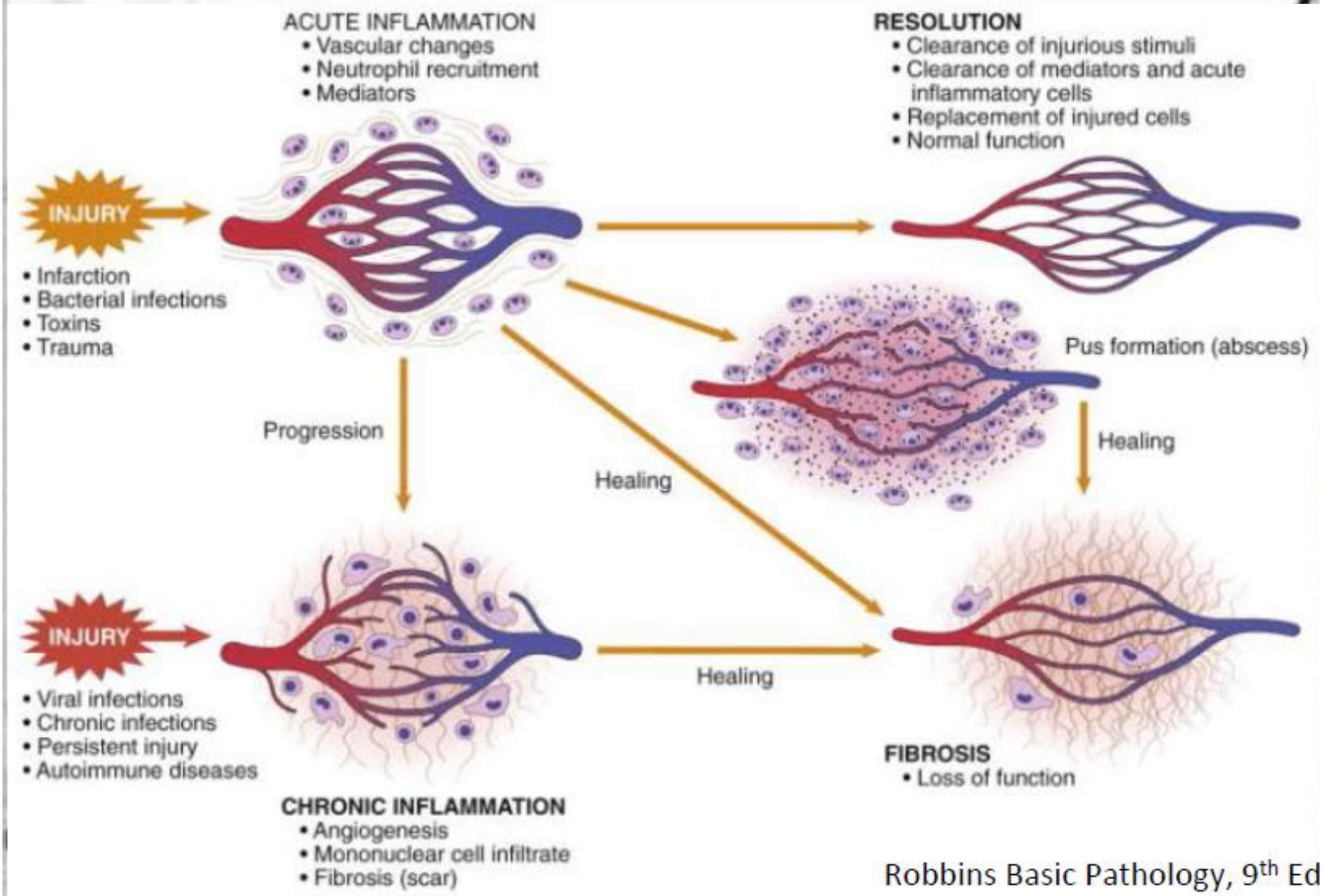

Allergy
Fibrosis
Metaplasia
Deficient immune response
Chronic infection
Over-reactive
immunity
Immunopathology
Sepsis
Host fitness
Deficient
Excessive
Th2
Treg
Th1/Th17
Controls microparasites
Controls macroparasites

Features of Acute and Chronic Inflammation

Feature	Acute	Chronic
Onset	Fast: minutes or hours	Slow: days
Cellular infiltrate	Mainly neutrophils	Monocytes/macrophages and lymphocytes
Tissue injury, fibrosis	Usually mild and self-limited	Often severe and progressive
Local and systemic signs	Prominent	Less prominent; may be subtle

Table 1 Types of inflammatory responses are categorized by intensity (low-grade versus high-grade) and duration (acute versus chronic)

Intensity	Duration	
	Acute	Chronic
Low-grade	Para-inflammation Metaplasia	Inflammatory diseases (diabetes mellitus, atherosclerosis) Autoimmune disorders Neurodegenerative diseases Tumor growth Tissue damage (fibrosis)
High-grade	Acute phase response Release of cytokines Neutrophil migration Recruitment of effector cells (neutrophils, macrophages) Localized tissue damage	Sepsis Cytokine storm Tissue destruction



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Indikasi Klinis

- Rasa tidak nyaman
- Demam
- Nyeri pada area inflamasi
- Peningkatan denyut nadi
- Lab→
  - Neutrofil darah tepi ↑
  - Laju sedimentasi eritrosit ↑
  - Protein fase akut (contoh: CRP) ↑

Perbaikan Jaringan

Perbaikan jaringan terjadi melalui:

1. Pemusnahan dan pembuangan jaringan yang rusak
2. Regenerasi sel
3. Pembentukan jaringan granulasi