



SNS COLLEGE OF ALLIED HEALTH SCIENCES
SNS Kalvi Nagar, Coimbatore - 35
Affiliated to Dr MGR Medical University, Chennai



DEPARTMENT OF CARDIOPULMONARY PERFUSION CARE
TECHNOLOGY

COURSE NAME: GENERAL PATHOLOGY

I YEAR

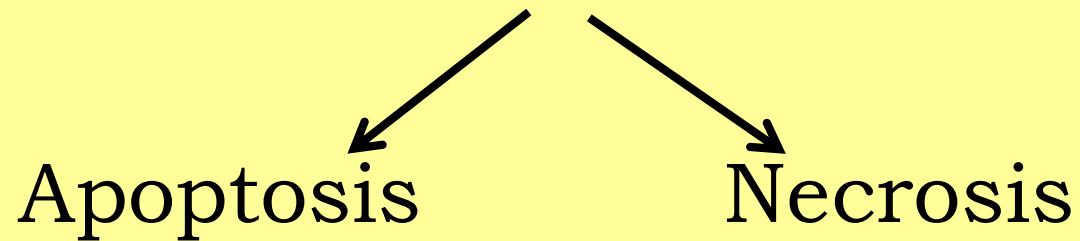
UNIT I: Cellular adaptation, Cell injury & cell death

TOPIC 1: Apoptosis & Necrosis



CELL DEATH

CELL DEATH





APOPTOSIS



- Apoptosis is defined as the natural or ***programed death*** of the cell under genetic control.
- It is also called '***cell suicide***'
- Apoptosis usually does not produce inflammatory reactions in the neighboring tissues.



SIGNIFICANCE



- Plays an important role in ***cellular homeostasis***
- Useful for ***removal of a cell that is damaged*** beyond repair by a virus or a toxin
- An essential event during the development and in adult stage.



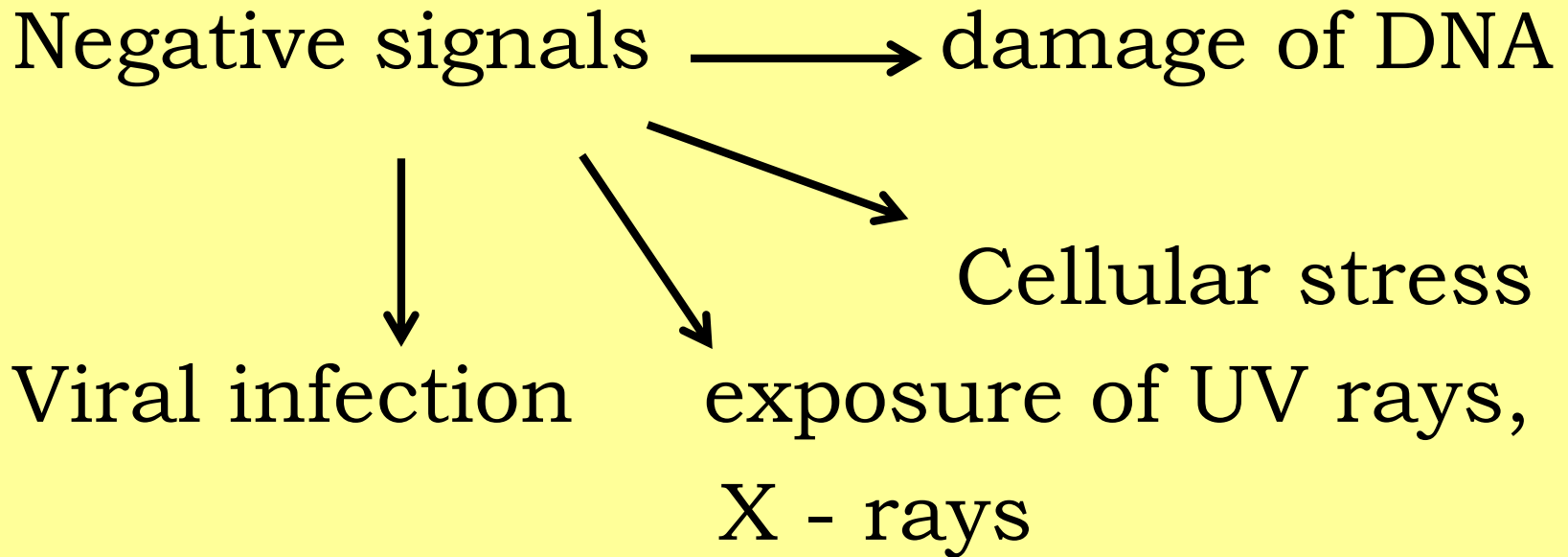
ACTIVATION OF APOPTOSIS



- Apoptosis is activated by either withdrawal of positive signals or arrival of negative signals.
- Positive signals \longrightarrow survival of cells (ex., nerve growth factors & Interleukin 2)
- Negative signals \longrightarrow apoptosis



ACTIVATION OF APOPTOSIS





ROLE OF MITOCHONDRIA IN APOPTOSIS



External or internal stimuli

caspases

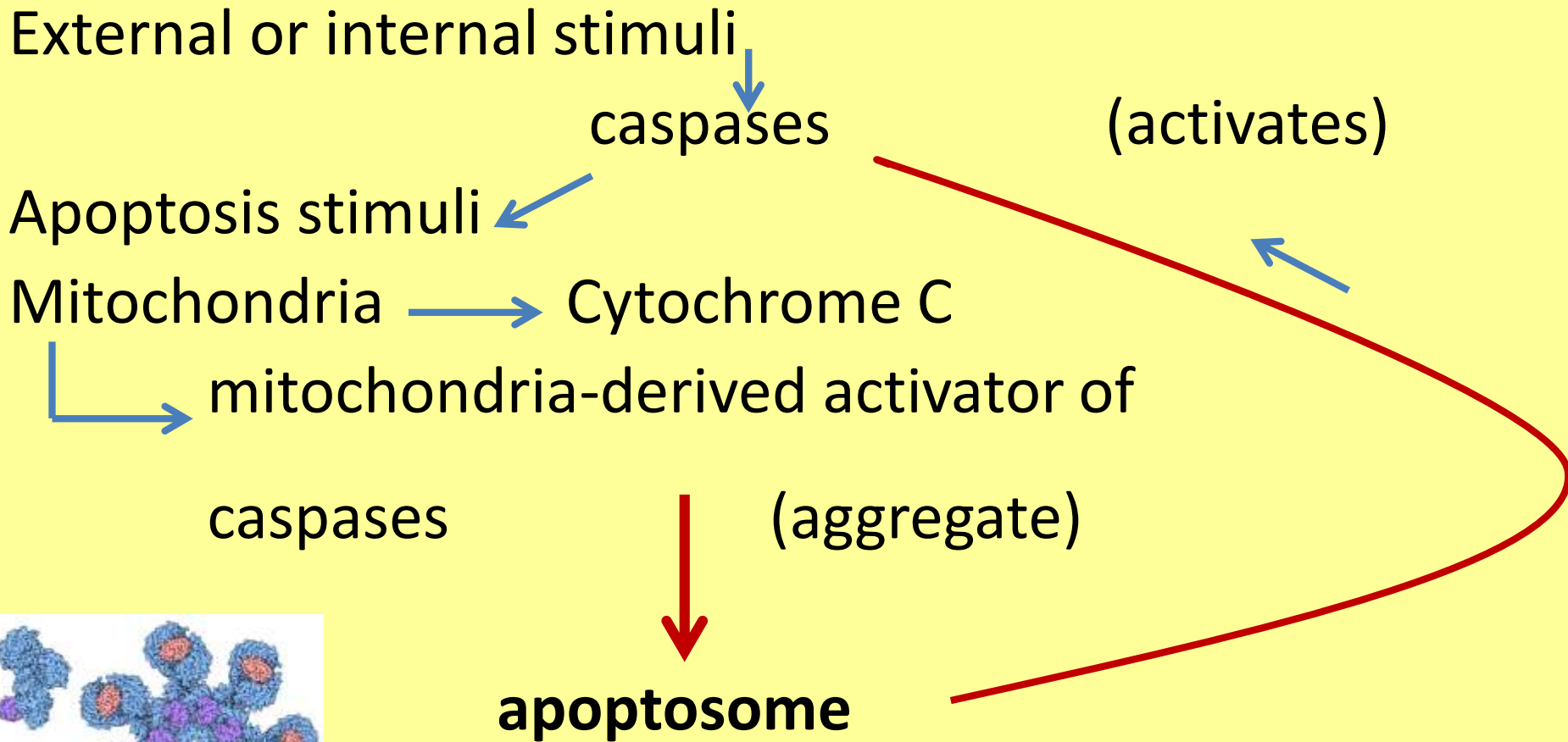
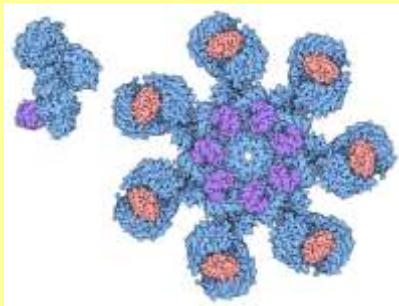
(activates)

Apoptosis stimuli

Mitochondria → Cytochrome C

mitochondria-derived activator of
caspases (aggregate)

apoptosome



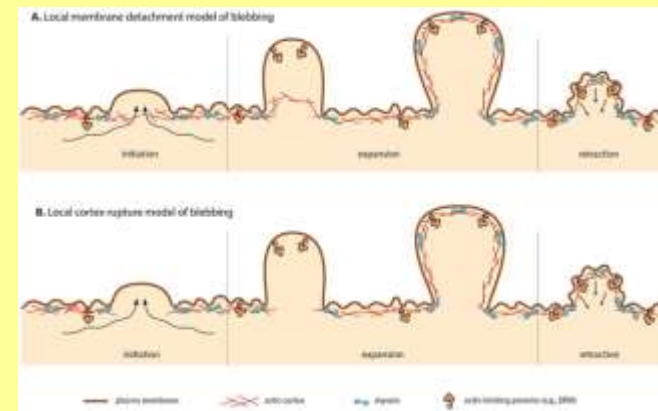


APOPTOSIS PROCESS

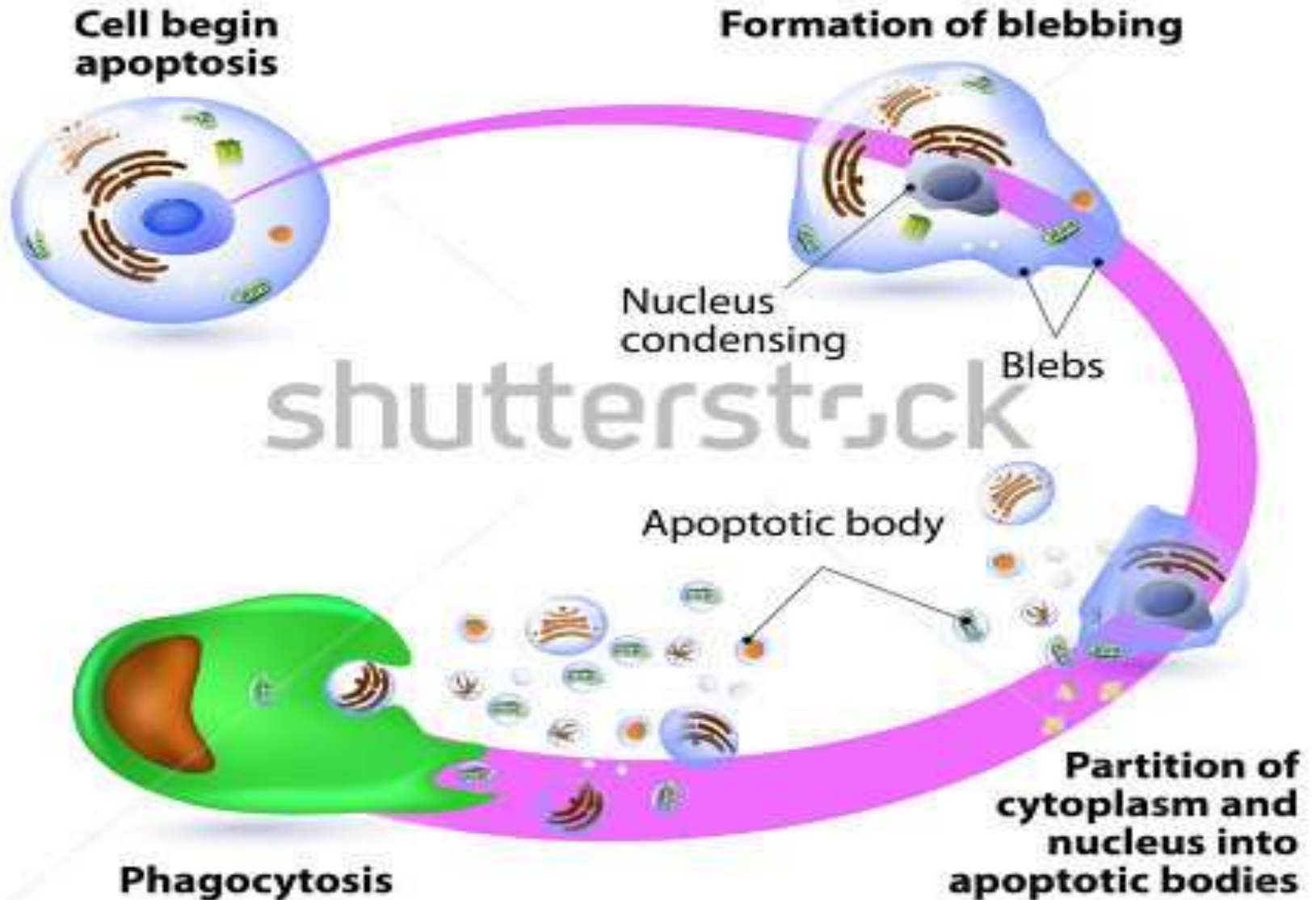


These changes in apoptosis are,

- Blebbing
- Cell shrinkage
- Nuclear fragmentation
- Chromatin condensation
- Chromosomal DNA fragmentation



APOPTOSIS



shutterstock



ABNORMALITIES DUE TO TOO MUCH APOPTOSIS



Ischemic related injuries

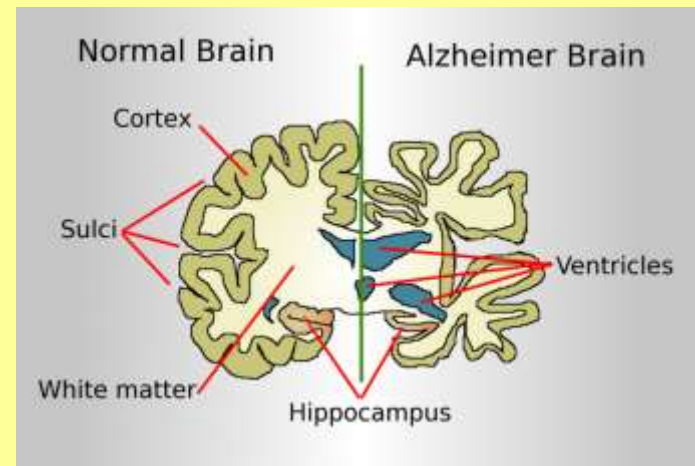
Autoimmune diseases like:

i. Hemolytic anemia

ii. Thrombocytopenia

ii. Acquired immunodeficiency syndrome (AIDS)

Neurodegenerative diseases like Alzheimer's disease.





ABNORMALITIES DUE TO LITTLE APOPTOSIS



- Cancer
- Autoimmune lympho-proliferative syndrome (ALPS).



SIGNIFICANCE OF APOPTOSIS



- During development many cells are produced in excess which eventually undergo programmed cell death and thereby contribute to sculpturing many organs and tissues
- In human body about one lakh cells are produced every second by mitosis and a similar number die by apoptosis
- Between 50 and 70 billion cells die each day due to apoptosis in the average human adult.



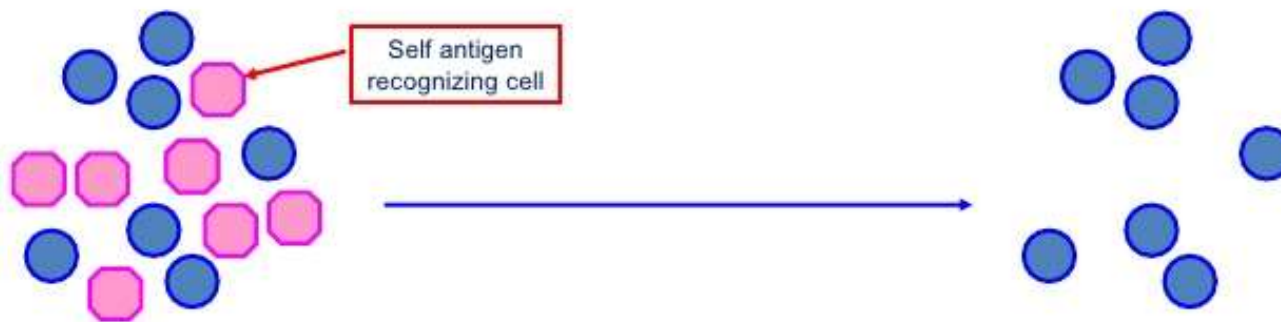
Significance



- Programmed destruction during embryogenesis
- Involution of hormone dependent tissues
- Cell loss in proliferating cell populations
- Elimination of harmful self- reactive lymphocytes
- Death of host cells

Apoptosis: in embryogenesis

Immunity (eliminates dangerous cells):

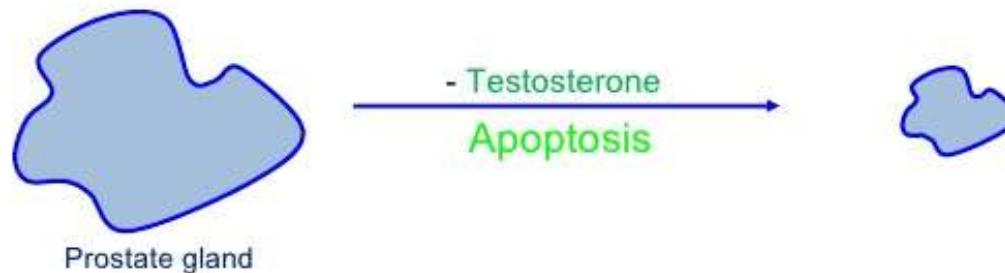


Organ size (eliminates excess cells):



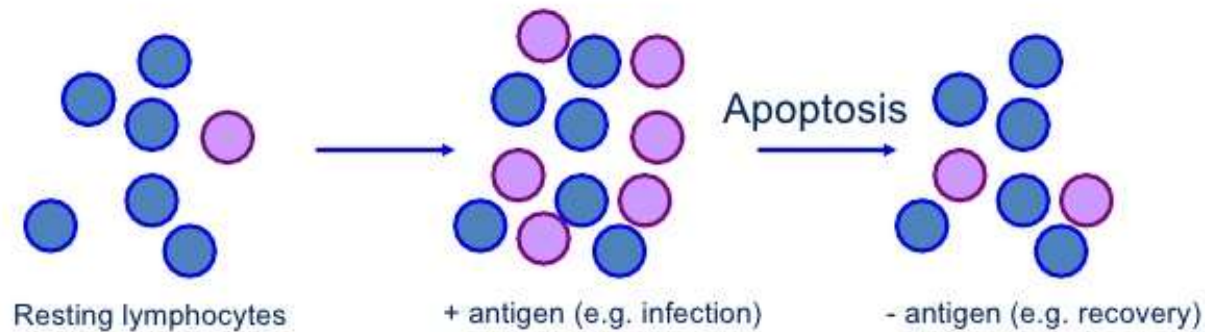
Apoptosis: importance in adults

Tissue remodeling (eliminates cells no longer needed):



Apoptosis: importance in adults

Tissue remodeling (eliminates cells no longer needed):





NECROSIS



NECROSIS



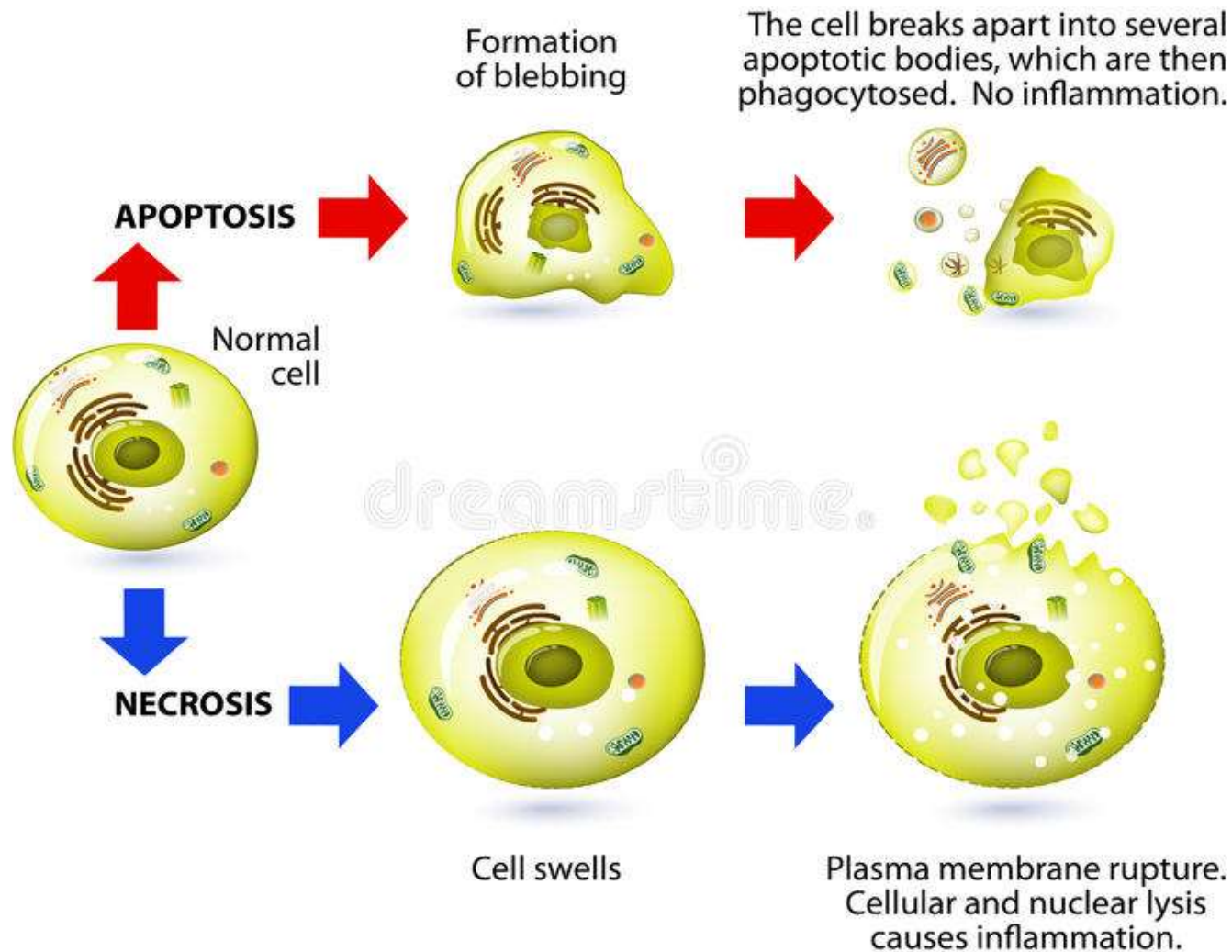
- Necrosis (means 'dead' in Greek) is the uncontrolled and ***unprogramed death*** of cells due to unexpected and accidental damage.
- It is also called '***cell murder***'



CAUSES OF NECROSIS



- Injury
- Infection
- Inflammation
- Infarction and cancer
- Heat
- Radiation
- Trauma
- Hypoxia
- Exposure to toxins.





Necrosis results in lethal disruption of cell structure and activity

Cell swells



Damage of cell membrane



Intracellular contents leak



Ca⁺⁺ release (damage mitochondria)



Lysosomal enzymes



Disassembled cell



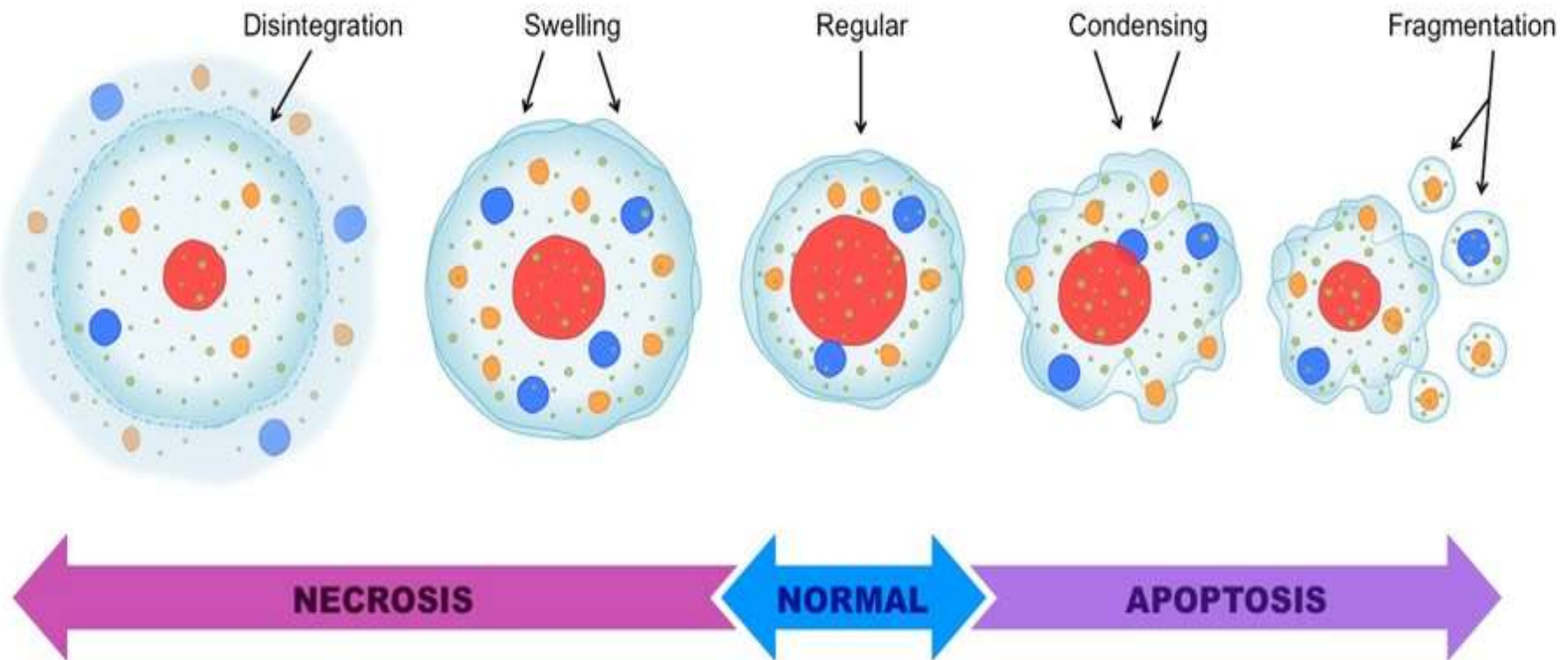
REACTION OF NEIGHBOURING TISSUES AFTER NECROSIS



- Dilatation of capillaries → Increase blood flow
- Increase in the temperature → reddening
- Release of histamine → induce pain
- Migration of leukocytes
- Movement of water → local edema
- Engulfing and digestion of cellular debris
- Formation of pus → dead leukocytes
- tissue growth in the area & wound healing.



NECROSIS & APOPTOSIS





	Necrosis <i>(uncontrolled cell death)</i>	Apoptosis <i>(programmed cell suicide)</i>
Size	Cellular swelling	Cellular shrinkage
	Many cells affected	One cell affected
Uptake	Cell contents ingested by macrophages	Cell contents ingested by neighbouring cells
	Significant inflammation	No inflammatory response
Membrane	Loss of membrane integrity	Membrane blebbing, but integrity maintained
	Cell lysis occurs	Apoptotic bodies form
Organelles	Organelle swelling and lysosomal leakage	Mitochondria release pro-apoptotic proteins
	Random degradation of DNA	Chromatin condensation and non-random DNA degradation



TYPES OF NECROSIS



- Coagulative necrosis
- Liquefactive necrosis
- Caseous necrosis
- Fat necrosis
- Fibrinoid necrosis



COAGULATIVE NECROSIS



- Preservation of general tissue architecture
- Affected tissue is firm Denaturation of structural proteins and enzymatic digestion of cells. Example – Heart, kidney, spleen.





LIQUIFACTIVE NECROSIS



- The tissue becomes liquid viscous mass
- Material is creamy yellow in colour
- Seen in brain, abscess.





WET GANGRENE



- Occurs in moist tissues like mouth, bowel, lung, cervix, Diabetic foot Bed sores

Wet Gangrene

- **Diabetic foot**

- high sugar content in the necrosed tissue which favours growth of bacteria.



- **Bed sores**

- bed-ridden patient due to pressure on sites like the sacrum, buttocks and heels





DRY GANGRENE



- Toes and feet, hand due to arteriosclerosis

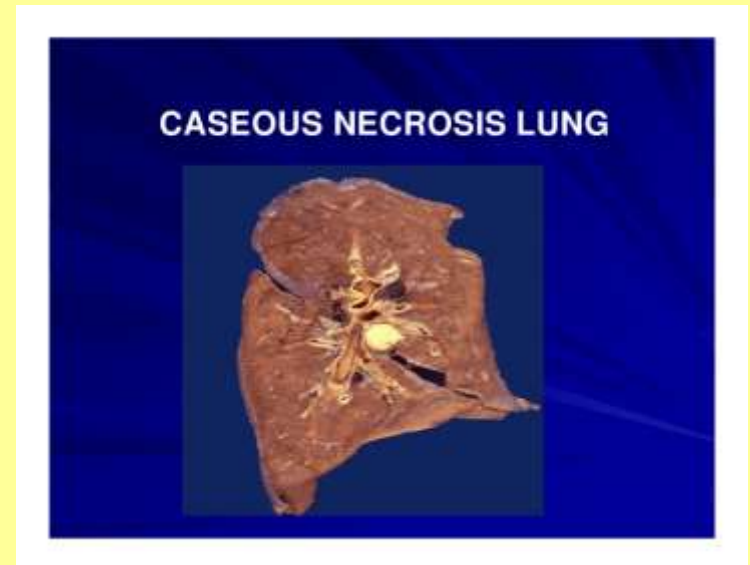




CASEOUS NECROSIS



- Type of coagulative necrosis
- Seen in Tuberculosis infections
- Tissue is cheesy white in appearance
- The tissue architecture is preserved





FAT NECROSIS



- Seen in pancreas, breast
- In acute pancreatitis ,activated lipase causes fat necrosis.
- Grossly visible chalky white areas.
- Presence of shadowy outlines of necrotic cells.





FIBRINOID NECROSIS



- Deposition of fibrin like material Seen in immunologic cell injury, hypertension ,peptic ulcer.

