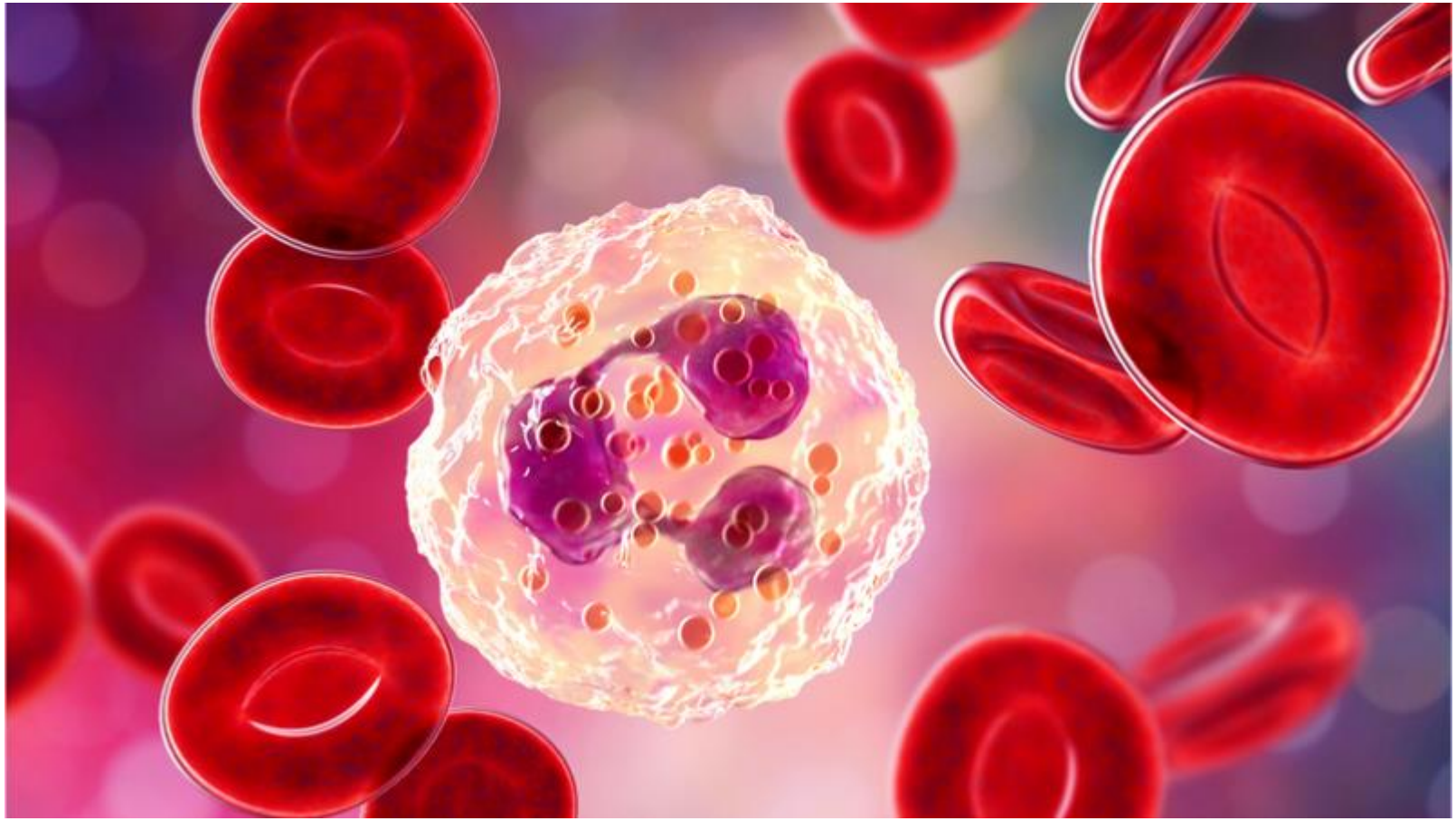


Inflammation II.

Balázs Csernus

Morphologic patterns of acute inflammation

- Serous inflammation – inflammatio serosa
- Fibrinous inflammation – inflammatio fibrinosa
- Purulent inflammation – inflammatio purulenta
- Hemorrhagic inflammation – inflammatio haemorrhagica
- Gangrenous inflammation – inflammatio ichorosa seu gangraenosa

Fibrinous inflammation

Exudate: Main component of exudate is fibrin - more severe injuries resulting in greater vascular permeability

- Dull appearance of surfaces (instead of shiny and glistening)
- Apperance of fibrin fibers (eosinophilic network)
- Can be removed by scraping/hyperaemia underneath
- Characteristic friction rub (scratching sound)
- Sharp pain (with movement)
- Sterile (autoimmune) or bacterial origin
- Natural “glue” – used in plastic surgery

Fibrinous inflammation

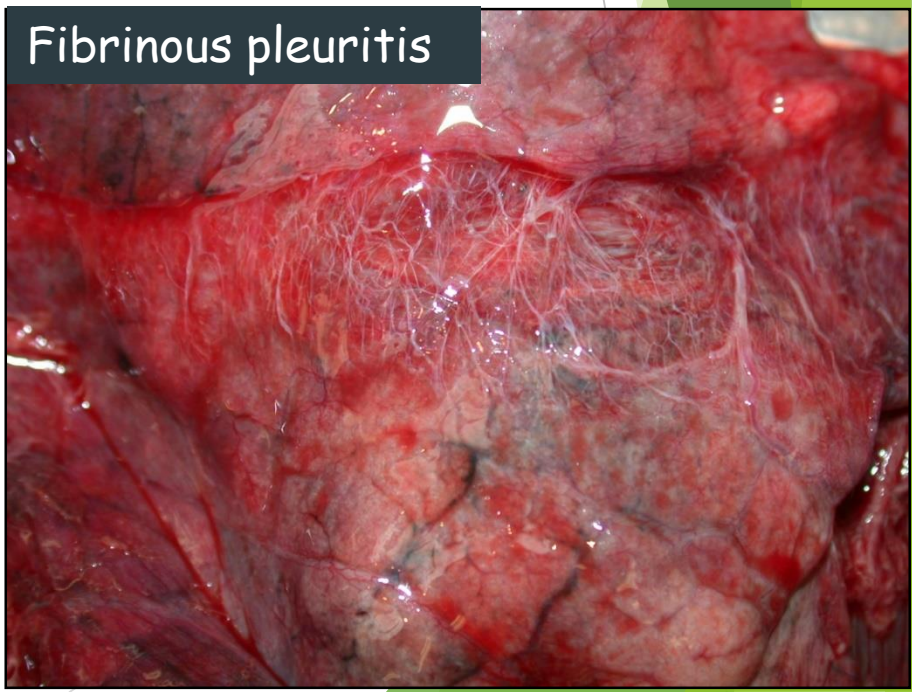
Examples: Serous cavities

- Fibrinous pericarditis (cor villosum, Dressler sy)
- Fibrinous pleuritis (SLE, uraemia)
- Intraarticular cavities

Fibrinous pericarditis

"Bread and Butter" Pericarditis

Fibrinous pleuritis



Fibrinous inflammation

Examples: Mucosal surfaces

- larynx - diphteria (Corynebacterium diphteriae)
- colon - dysentery (Shigella)
  - pseudomembranous colitis (Clostridium difficile)

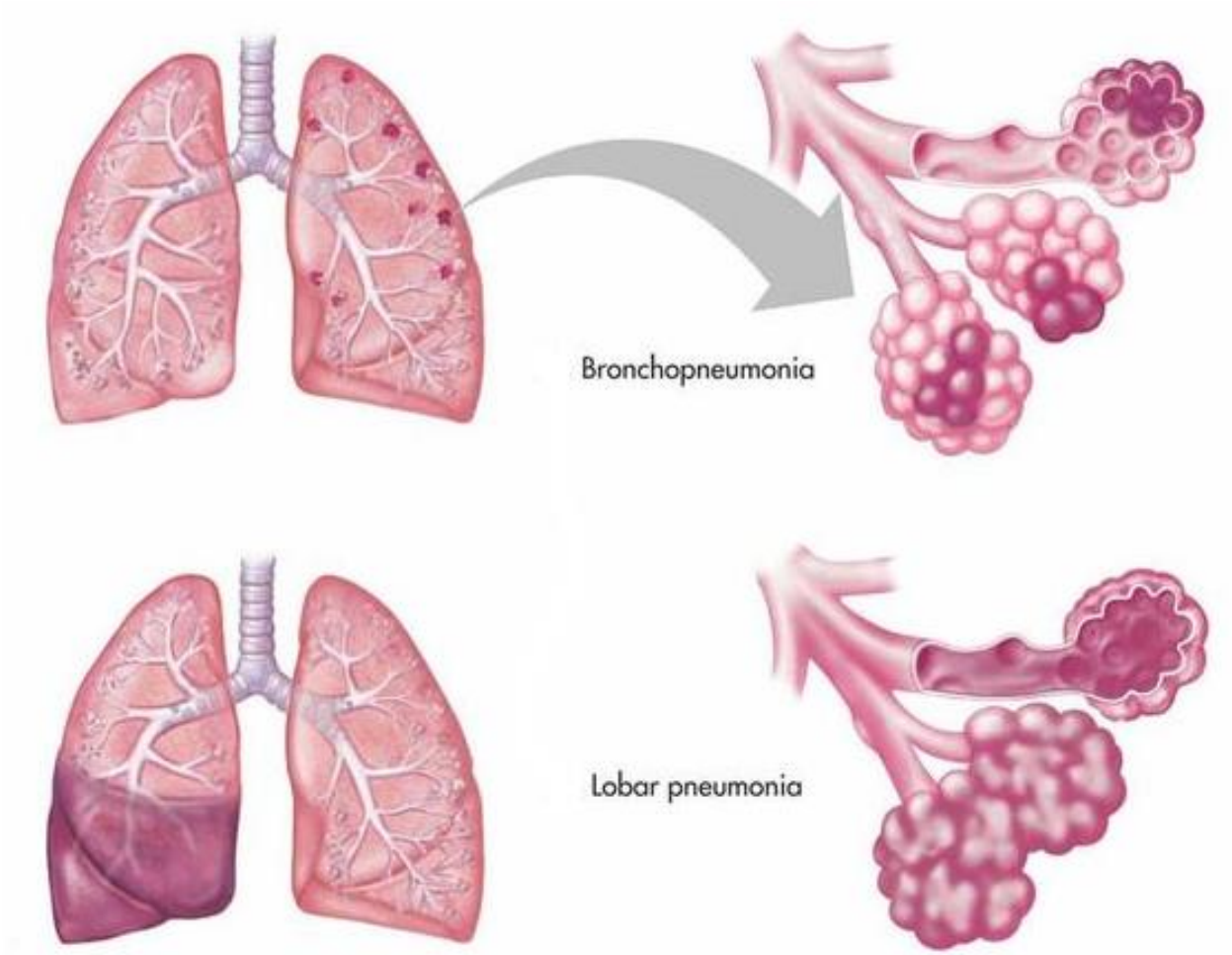
Fibrinous inflammation

Examples: Parenchymal organs

- Lobar pneumonia

- 90% Streprococcus pneumonia
- diffuse involvement of lung parenchyma
- accompanied by fibinous pleuritis
- affects all alveoli of the region
- bronchioles are not affected
- Characteristic stages (each lasts 2 days)
  - Congestion - oedema
  - Red hepatization (hepatisatio rubra) – rbc+fibrin
  - Grey hepatization (hepatisatio grisea) – fibrin dominates
  - (Yellow hepatization – in case large amount of neutrophils)
  - Resolution – fibrinolysis + neutrophils

Lobar pneumonia vs bronchopneumonia



Outcome of fibrinous inflammation

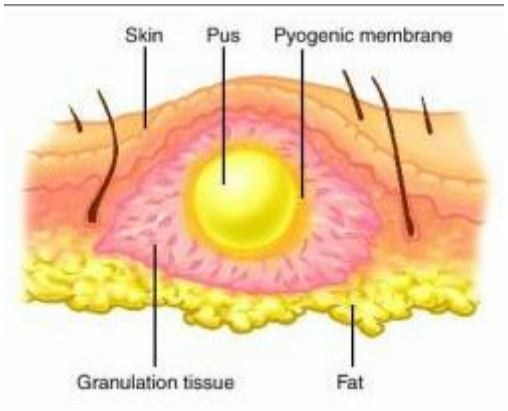
- Resolution
  - Exudate degraded by fibrinolysis, accumulated debris removed by macrophages, normal tissue architecture is restored
- Organization
  - Faliure to completely remove fibrin in time, ingrowth of fibroblasts and blood vessels, ultimately leading to scarring
  - Fibrous scar bridges tissues and resticts movements (carnification)
- Death
  - Diphteria of larynx – asphyxia

Purulent inflammation

Exudate: pus (dead leukocytes + protein rich fluid)

- most common form of acute inflammation
- exudate characterized by neutrophils
- caused by pyogenic bacteria
- primary or secondary events (superinfection – necrosis)
- pus may have characteristic apperarance
  - Pseudomonas – greenish pus (pyocyanin pigment)
  - Klebsiella – mucinous pus
  - Actinomyces - sulphur granules

Forms of pus accumulation

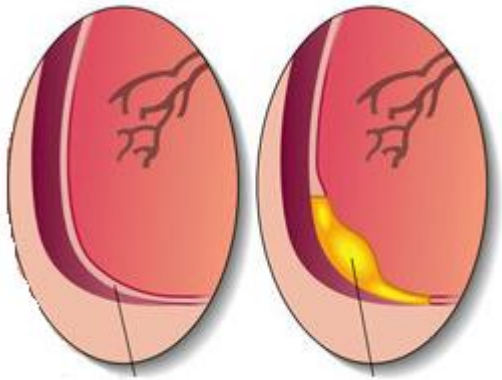


Abscess – newly formed cavity (needs draining)

- Lung abscess
- Brain abscess

Empyema – preformed body cavity

- Empyema thoracis
- Gallbladder empyema
- Sinus empyema

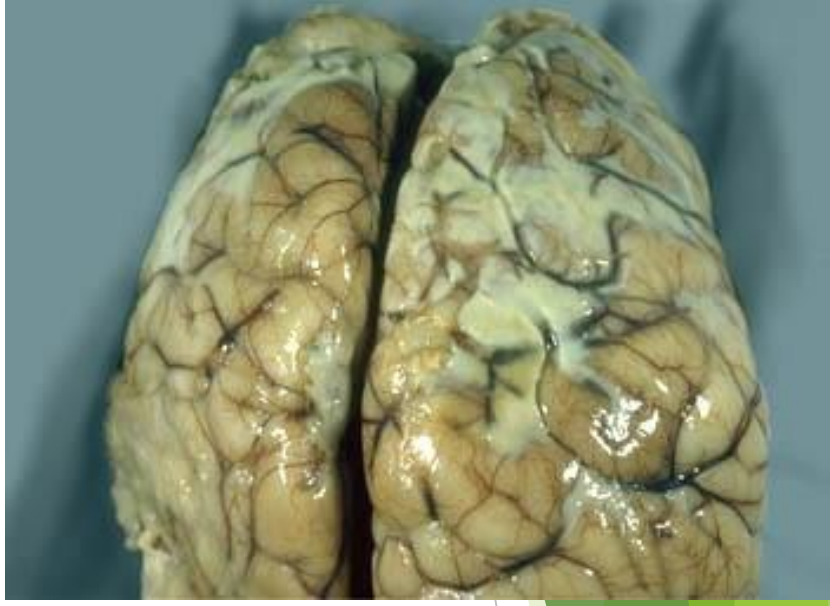


Phlegmon – suppurative inflammation of the soft fibrous tissues

- Muscular phlegmon
- Phlegmon of the floor of the mouth
  Mediastinal phlegmon

Purulent inflammation

Purulent meningitis



- Caused by pyogenic bacteria or fungi
  - Neisseria meningitides, Streptococci, E. coli, H. influenzae
- Routes of development
  - Hematogen spread (nasopharingitis, pneumonia)
  - Direct spread (middle ear infection, sinusitis, mastoiditis)
  - Trauma
- Fulminant cases may be lethal within 24 hours (children)
- Oedema – brain stem herniation
- Clinical: headache, neck stiffness, fever, altered mental status, petechiae, photophobia
- Waterhouse-Friderichsen syndrome – apoplexia gl. suprarenalis

Purulent inflammation

Staphylococcus infections

- Skin infections (pyodermas)
  - Folliculitis
  - Furuncule
  - Paronychia, panaritium
  - Hydradenitis
- Osteomyelitis
- Mastitis
- MRSA (methicillin resistant)

Purulent inflammation

Streptococci infections

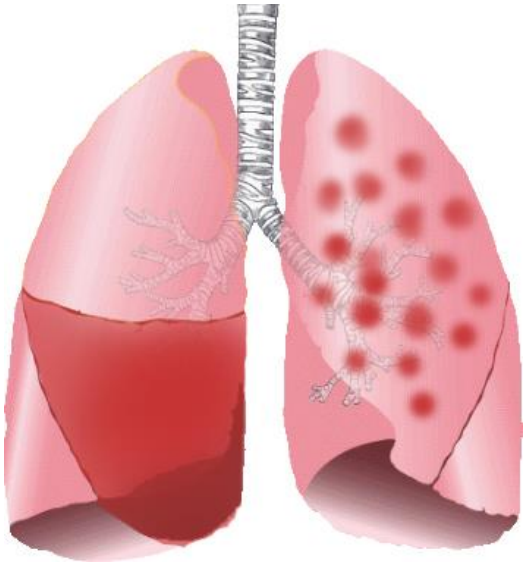
- Follicular tonsillitis
- Eryisipelas
- Scarlet fever
- Bronchopneumonia
- Pharingitis

Raspberry tounge

Purulent inflammation

Bronchopneumonia

- Lung infection by pyogenic bacteria
- Multifocal
- Intact alveoli between foci
- May be confluent or abscess forming



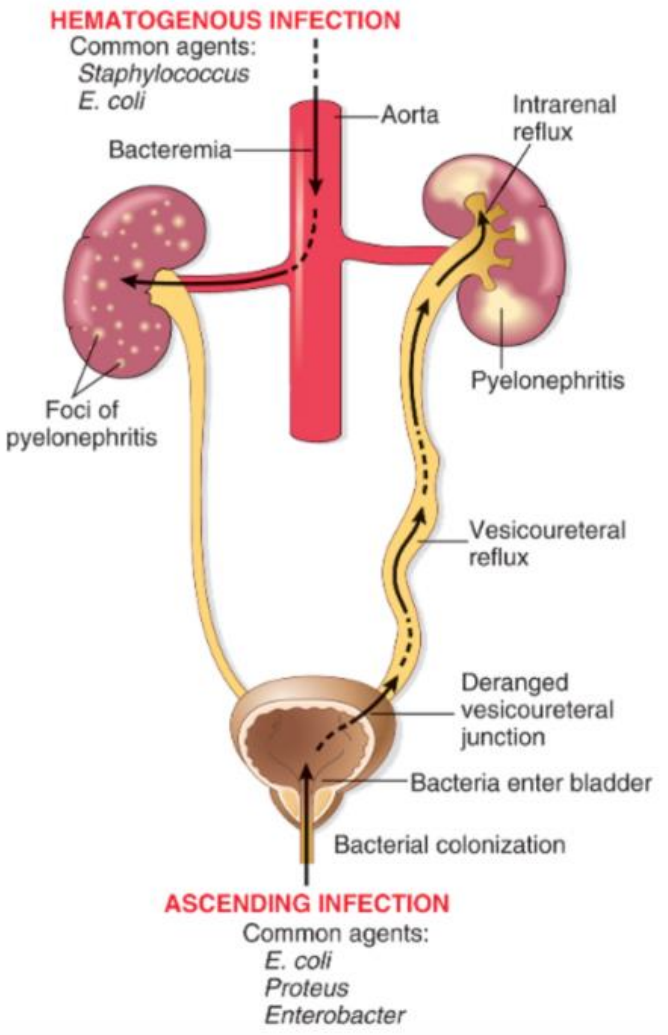
Causes: (pyogenic bacteria)

Staphylococcus aureus
Haemophilus influenzae
Pseudomonas aeruginosa
Escherichia coli
Klebsiella pneumoniae
Proteus species

Purulent inflammation

Acute pyelonephritis

- Purulent infection of renal pelvis
- Caused by E. coli, Proteus, Enterobacter
- Usually ascending infection from urinary bladder
- Common in pregnant women or men with prostate hyperplasia
- Symtoms: Fever, flan pain, dysuria
- May lead to urinary sepsis (pyelonephritis aposthematosa)



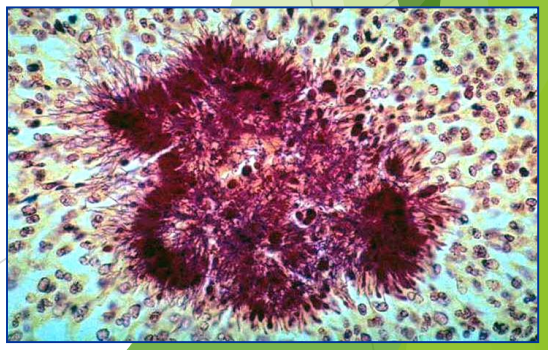
Purulent inflammation

Gonorrhoea

- STD caused by Neisseria gonorrhoeae (Gram-neg)
- Humans are the only reservoir
- Causes purulent urethritis (strictures, sterility)
- Salpingitis in women
- Perinatal conjunctivitis (blenorrhoea)

Actinomycosis

- Filamentous bacterium (Actinomyces israelii)
- Part of oral flora (gums, tonsillar crypts)
- Anaerobic bacteria
- Sulfur granules, fistula formation
- 4 forms
  - Cervico-facial
  - Pulmonary
  - Adominal
  - Pelvic (associated with IUD)



Fibrinosopurulent inflammation

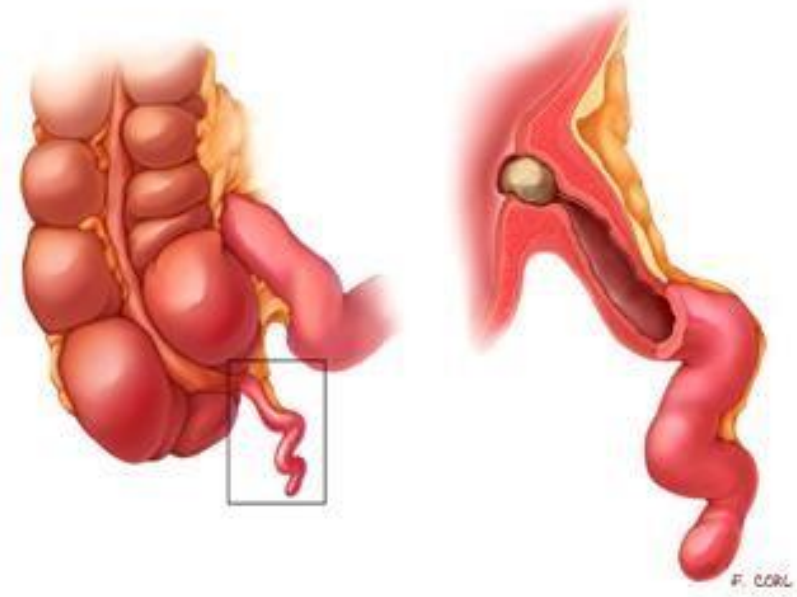
Acute appendicitis

- Cause: luminal obstruction (fecolith, food, lymphoid hyperplasia)
  bacterial overgrowth,

- Pain migrating from periumbilical region to RLQ
- Fever, vomiting
- McBurney point tenderness, psoas-sign
- Common in children 10-12y

- Stages
  - Early acute appendicitis (swollen)
  - Fibrinosopurulent appendicitis
  - Plegmonous appendicitis (ulcerative)
  - Gangrenous appendicitis

- Complications:
  - Perforation
  - Peritonitis
  - Periappendicular abscess



Hemorrhagic inflammation

Exudate: contains red blood cells (vessel injury)

Examples:

- influenza virus pneumonia (H1N1)
- COVID pneumonia
- anthrax (Bacillus anthracis)
- variola vera (hemorrhagic smallpox)
- plague (Yersinia pestis)
- ebola virus infections

SOURCE: Base Hospital No. 1. Base Hospital Center.

COLLECTED AT: Base Laboratory Hospital Center Vichy.

STATISTICAL DATA:

Name: Cauvel, H. D. Rank: Pvt. Organzn: M.D.B.H.76.

Age: .. Race: White.

Date of Death: October 8th. 1918 Place: B.H. NO.1.

Date of Autopsy: " 9th. 1918 Place: B.Lab. Hosp. Center Vichy.

Pathologist: Capt. Harrison S.Martland,M.C. Autopsy No.55.

CLINICAL DATA:

Patient admitted to the Hospital during the pandemic of influenza and pneumonia, complaining of general malaise and headache. Death three days after admission.

LEGEND:

The picture shows the red lung type of pneumonia., a type of pneumonia which was peculiar to the pandemic. The lungs are characterized by intense and active congestion well marked, and that the lesions resembles grossly the early stage of red hepatization in lobar pneumonia of the lungs in the pneumonic form of bubonic plague. The lungs on cut section drip bloody and frothy serum, and there is absence of pus in the bronchi and very little fibrin formation. There is an intense hemorrhagic bronchitis which extends into the large bronchi and intense injection of the trachea and larynx. This type of pneumonia is due to organisms of the pneumococcus or streptococcus group. The pneumococcus as a causative organism slightly predominates.

UNITED STATES BASE HOSPITAL No 115
MEDICAL ARTIST W. T. SCHWARZ

Influenza pneumonia

- Citokine storm
- ARDS

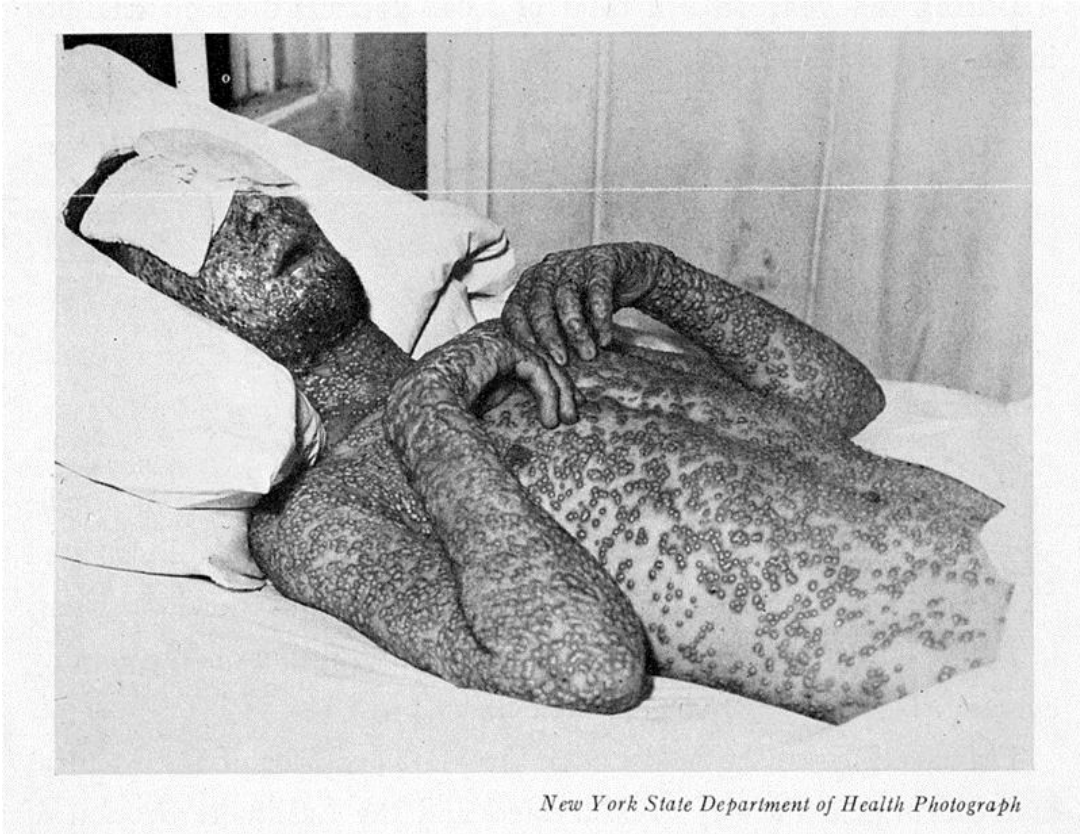
Anthrax

- Bacillus anthracis
- Gram+, anaerobic
- spore forming, resistant
- Forms:
  - skin, lung, intestinal
- edematoxin, lethal toxin
- Inhaled form is usually fatal

Anthrax- skin lesion

Smallpox- variola vera

- Infectious disease caused by variola virus
- Virus is extinct since 1980 by WHO
- 30% mortality
- killed 300 million people in the 20th century
- characterized by skin rash
- heals with remaining scars



New York State Department of Health Photograph

Gangrenous inflammation

Exudate: Contains necrotic tissue debris

Examples: aspiration pneumonia

perforation of the appendix

perforation of the esophagus (gangrenous mediastinitis)

snake envenomation

septic abortion

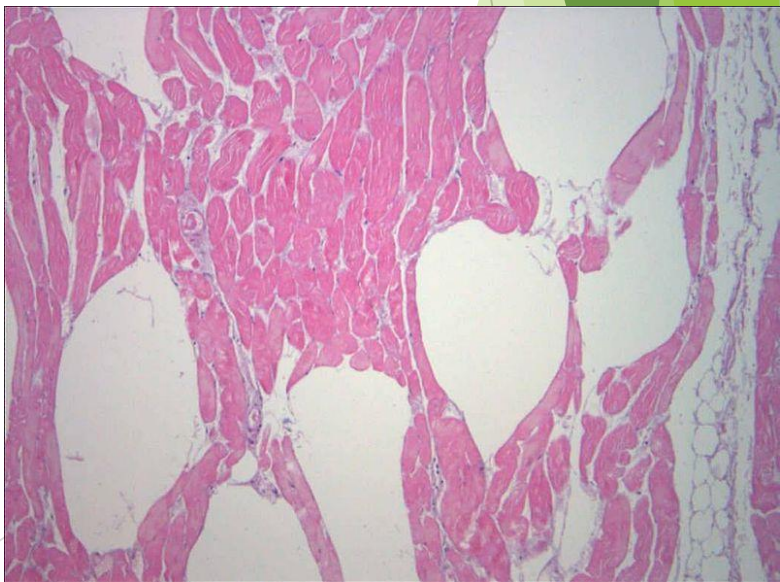
Gangrenous appendicitis

Dehiscent wound

Gangrenous inflammation

Gas gangrene

- infection by Clostridium perfringens
- soil-borne, anaerobic, spore forming
- war-wounds
- soft tissue necrosis (myonecrosis)
- Exotoxins (alpha, theta)
- enter trough skin damage
- sepsis, shock
- putrid exudate
- crepitation due to gas production



Septicaemia
(when infections become generalized)

Definitions:

Sepsis: life-threatening organ dysfunction caused by dysregulated host response to a new infecton

Septic shock: subset of sepsis with profound circulatory and metabolic abnormalities associated with increased mortality

Etiology:

- 90% gram-positive and gram-negative bacteria

Sterptococci	E. coli
Staphilococci	Klebsiella pneumonia
Enterococci	Pseudomonas

- fungal infections
- hemocultures are negative in 50% of cases

Septicaemia
(when infections become generalized)

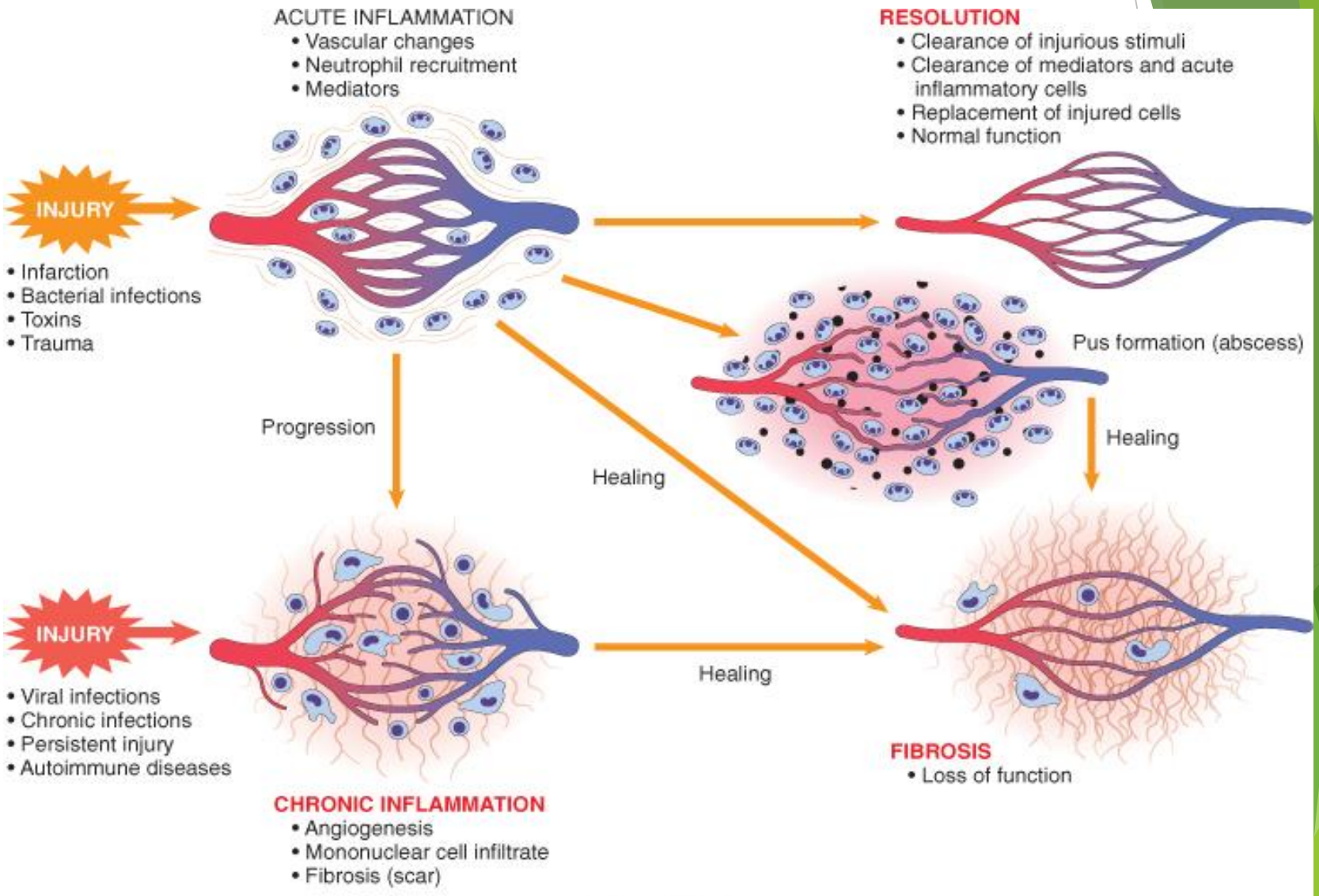
Site of infection:

- Respiratory (45-60%)
- Bloodstream (20%)
- Skin (14%)
- Urinary system (12-20%)

Pathomechanism:

- cytokine storm (imbalance of pro- and anti inflammatory cytokines)
- bacteraemia may be absent (G- bacteria LPS)
- vasodilative shock – hypotension - hypoperfusion
- endothelial damage – DIC (fibrinogen, thrombocyte ⬇)
- MOFS
- Marker: procalcitonin level
- SIRS (systemic inflammatory response syndrome) – non-infectious sepsis

Outcomes of acute inflammation



Chronic inflammation

Reasons:

- persisting infection or prolonged exposure to irritants (intracell. surviving of agents - TBC)
- repeated acute inflammations (otitis, rhinitis)
- primary chronic inflammation - low virulence, sterile inflammations (silicosis)
- autoimmune reactions (rheumatoid arthritis, glomerulonephritides, multiple sclerosis)

Cellular component - ("round cell" infiltrate)

- lymphocytes (T and B), plasma cells
- eosinophils – parasites, allergies
- monocytes / macrophages activation by various mediators