Ministry of Higher Education and Scientific Research
University of Baghdad
College of Science
Department of Biology

Theoretical Clinical Analysis

2020-2021

المرحلة الرابعة _ الدراستين الصباحية و المسائية
الفصل الدراسي الثاني

تدريسيي المادة :

ا.د. رنا سعدي عبود

ا.م.د. نغم شاكر محمد

ا.م.د. حسن مجيد رشيد

ا.م.د. ميس عماد احمد

Clinical Analysis
DIAGNOSIS OF INFECTIOUS DISEASES Lec.1

The diagnosis of infectious diseases requires an understanding of the presenting clinical manifestations and a knowledge of microbiology.

The methods that used for identification of microorganisms fall into **three categories**:

1- Phenotypic- morphology (micro and macroscopic)

2- Immunological- serological analysis

3- Genotypic- genetic techniques

I - Diagnosis of Respiratory Tract(RT) Infections :

RT is broadly divided into:

1- Upper respiratory tract

2- Lower respiratory tract

- Upper Respiratory Tract Infection

  upper respiratory infections (URI) include the common cold, pharyngitis, epiglottitis, and laryngitis . Etiologic agents associated with URI include viruses, bacteria, mycoplasma and fungi. Complications are sinusitis and otitismedia may follow.

- Lower Respiratory Tract Infections

  As shown in the figure below

- A. SPECIMENS:

❖ Upper Respiratory Tract

1. Throat

- Most "**sore throats**" are due to viral infection. Only 5–10% of "sore throats" in adults and 15– 20% in children are associated with bacterial infections. The finding of yellowish exudate or a grayish membrane must induce the suspicion that Lancefield group A β-hemolytic streptococcal, diphtherial, or candidal infection exists; such signs may also be present in infectious mononucleosis, adenovirus, and other virus infections.
- Throat swabs are taken from each tonsillar area and from the posterior pharyngeal wall.

2. Nasopharynx

- Specimens from the nasopharynx are studied infrequently because special techniques must be used to obtain them. Whooping cough is diagnosed by culture of *B. pertussis* from nasopharyngeal or nasal washings.

3- Other Diarrhea-Causing Toxins : *Vibrio parahaemolyticus*, Food-poisoning strains of *Staphylococcus aureus* and *Clostridium perfringens.*

4- Gastrointestinal Disease Caused by Invasive Bacteria : invasive bacteria exert their main impact on the host by causing gross destruction of the epithelial architecture (*Salmonella, Shigella, Campylobacter*, invasive *E coli*, and *Yersinia*). The enteric viruses also invade intestinal epithelial cells.

5- Viral Diarrheas : Rotavirus diarrhea affects mostly young children; Calicivirus causes disease in all age groups

6- Parasitic Diarrheas : Some protozoa (especially *Entamoeba histolytica* and *Giardia lamblia*) as well as some intestinal helminths can cause diarrheal disease.

Clinical Diagnosis

- **A. SPECIMENS**

  Feces and rectal swabs. The presence of bile may reveal infection of the biliary tract. The presence of blood, mucus, leukocytes or helminths and their ova must be noted .

- **B. Culture**

  Specimens are suspended in broth and cultured on ordinary as well as differential media (eg, MacConkey agar, EMB agar) to permit separation of non-lactose fermenting gram-negative rods from other enteric bacteria.

  - salmonella : specimen is also placed in an enrichment medium (eg, Selenite broth) for 18 hours before being plated on differential media (eg, Hektoen enteric or Shigella-Salmonella agar).

  - *Yersinia enterocolitica* (storage of fecal suspensions for 2 weeks at 4 °C, but it can be isolated on Yersinia or Shigella-Salmonella agar incubated at 25 °C.

  - Vibrios grow best on Thiosulfate Citrate Bile Salts Sucrose agar (TCBS).

  - Campylobacters are isolated on Campy agar or Skirrow's selective medium incubated at 40–42 °C in 10% CO_2 with greatly reduced O_2 tension.

Lec.2

VI-Laboratory Diagnosis of Sexually Transmitted Infections (STDs)

The laboratory approach to the diagnosis of STDs is related to the sex of the patient , although some infections are common to both sexes like gonorrhea, syphilis and chlamydial infection but there are usually difference in the presenting symptoms , the sites and methods of specimens collection in these infections.

Genital infections and STDs in women

1-Acute vaginitis: is caused by *Trichomonas vaginalis* (protozoan) and *Candida albicans* or other yeast.

- **Trichomoniasis** is primarily an infection of the urogenital tract (urethra and the vagina) in women, is caused by protozoan parasite *Trichomonas vaginalis*

-Vulvovaginal candidiasis : is caused by *Candida albicans* (causing vaginal discharges and pain).

2-Bacterial vaginosis (BV) or very uncommonly **vaginal bacteriosis:** *is caused by Gardnerella vaginalis*, and anaerobic cocci , anaerobic vibrios and *Mycoplasma hominis* which is present in 50% of the sever cases of BV.

- Clinical manifestations include discomfort and pungent odor, a gray, thin, homogenous discharge .Characteristically, signs of inflammation are not present in the vaginal walls, although a few leukocytes may be present.

What causes a BV?

- Oftentimes, it derives from changes in the local microflora and overgrowth of 1 or more bacterial types. This may be due in part to a reduction or loss in *Lactobacillus* that normally keeps the vagina slightly acidic, and/or a reduction or loss of peroxide-producing bacterial strains, which protect against BV.

3- Cervisitis with or without Urethritis:

4- Uterine sepsis.

5-Toxic shock syndrome.

6- Genital ulceration.

7- Tuberculosis of uterus.

8-**Viruses.**

- **Microscopic examination**
- Both a wet film and gram stained film should be examined.
- Wet film is examined for the presence of *Trichomonas* (motile , rounded shaped)
- Examine under dark field microscope for *T.pallidum*.
- Fluorescein-conjugated monoclonal antibodies for *Chlamydia.*
- Gram stained film should be examined for candidiasis*: Candid*a G+ve yeast form, and G+ve hyphe (pseudomycelium) and bacterial vaginitis: G – ve bacilli *(Gardnerella vaginalis*).
- The presence of G-ve diplococcic intracellularly almost diagnosis as gonorrhea.

- **Culture:**
- **The specimen should be inoculated on** two plates of a rich Blood agar , one incubated at 35-37c˚ in 5% CO2 with moisture & the other in an aerobic atmosphere with CO2.
- ***Candida albicans*** can be recognized on the aerobic Blood agar and grow well on Colombia agar base + 5% Sheep blood agar + Naldixic acid (CAN) , Sabouraud agar or Malt extract agar.
- ***N. gonorrhoeae*** grow well on Thayer Martin (TM) medium which contains the antibiotics (Vancomycin , Colistin , Nastatin).

  Modified New York City medium (MNYC medium) is preferred because it gives better growth and the use of Lincomycin as a selective agent avoids the problem of Vancomycin sensitivity.
- ***Gardnerella*** and **Sterptococci** grow on CAN.
- ***Trichomonas vaginalis,*** the Cysteine peptone liver infusion maltose (CPLM) medium is used under anaerobic condition.
- Cell culture techniques are recommended for the isolation of ***Chlamydia*** species

Lec.3

VI-Laboratory Diagnosis of Sexually Transmitted Infections (STDs)

Genital infections in men

Genital infections in men

- The infections in men are mostly caused by the same organisms as in women , include :-
- **1-Urethritis** : is classified as gonococcal or non gonococcal (NGU). Most cases of NGU are caused by *Chlamydia trachomatis* and *Ureaplasma* in 10% of cases .
- **2-Prostatitis** : is usually caused by gonococci or Chlamydia. Sub acute or chronic prostatitis found in older men is usually associated with the presence of coliform bacilli or enterococci.
- **3-Ulceration** *:* caused by Herpes simplex virus(usually type 2), *T. pallidum , Haemophilus ducreyi* and *Chlamydia.*
- **Collection of specimens and laboratory examination**
- Urethral discharge may be expressed directly on the slide for gram stain and be inoculated immediately on Chocolate agar and selective medium for the culture of gonococci . If specimens have to be transported to the laboratory the exudates from ulcers should be collected on a swab and put into a tube of Amie' s transport medium.
- For isolation of *Haemophilus ducreyi* a special agar (Mueller Hinton Chocolate Horse Blood agar) ˚.
- The gram stained films may show small pleomorphic G –ve rods or coccobacilli.
- Herpes simplex virus examined by immunofluorescent Abs or by ELISA.

- **SYPHILIS**
- Syphilis is a contagious venereal disease caused by the spirochete *Treponema pallidum*. The organism enters the body through a break in mucosa or epithelial layer.
- After a 10-60 day incubation, a painless inflammatory reaction producing a characteristic ulcerated lesion called a chancre usually appears at the site of entry.
- Syphilis is usually cured by penicillin, if treated early. If untreated, a generalized skin rash and other abnormalities will begin appearing six weeks to six months following the disappearance of the chancer (secondary stage syphilis). Again, the clinical symptoms may disappear (latent stage syphilis).
- The latent syphilis may continue throughout life, it may terminate with spontaneous cure, or it may advance to tertiary syphilis. Pregnant women with active syphilis (even primary stage) can transmit the organism to the unborn child (congenital syphilis).
- Tertiary Stage occurs anywhere from months to years after secondary stage, typically between 10 to 30 years (gummatous syphilis ,cardiovascular syphilis ,neurosyphilis).

- Many other medical conditions can produce false positive results, including some viruses (mononucleosis, hepatitis), drugs, pregnancy, rheumatic fever, rheumatoid arthritis, lupus, and leprosy.

*** Other tests which use modified VDRL Ag**

a. **The RPR (Rapid Plasma Reagin) test.**

b. USR – unheated serum reagin test.

c. RST – reagin screen test.

2-The Wassermann test.

B/ Treponemal Tests

- These tests measure antibody specific for *T. pallidum*. They are highly specific and highly sensitive. Treponemal tests are not currently used for general screening because they are expensive and time consuming to perform. Their use is limited to confirmation of positive reagin tests (to identify false-positive diagnoses) and in the (diagnosis of late syphilis when reagin tests may be nonreactive).

Leptospirosis
Lec 4

Zoonosis disease that can be transmitted from animals to humans.

It is caused by ***Leptospira interrogans***, it can enter the body through scratches or breaks in the skin.

The bacteria use blood as a means of travel.

- Can attach to several different receptors on the host cells-----attack different organs
- The kidney :causing kidney infections
- There are two phases an animal goes through when being infected by *L. interrogans*,
- -The leptosipremic acute phase (fever, nausea, headaches, and muscle pain) and
- The immune leptospirosis phase.(fever and may develop meningitis)

Laboratory tests

Samples

Swabbing the surface of a wound to collect cells or pus, aspiration of fluid or pus with a needle and syringe, and/or the collection of a tissue biopsy.

For fungal evaluation, scrapings of the skin may be collected.

If the patient is febrile or in shock or the infection accompanied by bacteremia , a sample of blood should be taken for culture.

Testing may include:

1-Naked eye examination:

The appearance of pus or exudates that should be noted.

-Color

-Consistency

-Odor

Staphylococcal lesion -------- the pus is typically creamy and thick in consistency with pus cells evident on microscopy.

Streptococcus pyogenes infection -------- the pus is straw colored and watery , with lysis of pus cells seen on microscopy.

3- Bacterial culture

4-Other tests that may be ordered include:

KOH prep – A rapid test performed to detect fungi in a sample.

Fungal culture – Ordered when a fungal infection is suspected.

Blood culture – Ordered when infection from a wound may have spread and septicemia is suspected.

Molecular testing to detect genetic material of a specific organism.

- Lec 5

Bacteremia

Bacteremia: is the presence of viable bacteria in the blood.

Septicemia: means the presence of microorganisms or their toxins in the blood.

Causes :

In the hospital, indwelling catheters are a frequent cause of bacteremia and subsequent nosocomial infections, ,dental procedures, urinary tract infections, peritonitis.

Fungemia

is the presence of fungi or yeasts in the blood.

Diagnosis

Blood culture, in which a sample of blood is allowed to incubate with a medium that promotes bacterial growth.

Blood culture is a microbiological culture of blood. It is employed to detect infections that are spreading through the bloodstream

A minimum of 10 ml of blood is taken through vein puncture and injected into **two or more** "blood bottles" with specific media for aerobic (Tryptic soy broth) and anaerobic organisms (thioglycollate broth).

Collect enough blood

-The blood is collected using aseptic technique. This requires that both the tops of the culture bottles and the vein puncture site of the patient are **cleaned** prior to collection with swabs **70%** isopropyl alcohol.

- 2-3 blood cultures should be taken separated by 1 hr. intervals or less if treatment can not be delayed . **Ordering multiple sets of cultures** 1-increases the probability of discovering a pathogenic organism in the blood and 2-reduces the probability of having a positive culture due to skin contaminants , so that the chance of missing a transient bacteremia (caused by *S.epidermidis*) is reduced and the pathogenic role of
- *S.epidermidis* is confirmed if they are recovered from multiple vein punctures (bacteremia in users of intravenous drugs)

- The blood should **be mixed** with 10 times its volume of broth(5 ml blood in 50 ml broth) **WHY?** to dilute any antibiotic present and to reduce the bactericidal effect of serum .
- After inoculating the culture bottles **incubated** at 37 c for 7 days

- **A sterile culture** shows a layer of sediment RBCs covered by a peal yellow transparent broth ,
- **Microbial growth** is evidenced by : a floccules deposit on top of the blood layer , turbidity , hemolysis , coagulation , gas production and white grains on the surface or deep in the blood layer
-

- . **If a culture bottle is positive**
- Gram Stain on the blood for a rapid identification
- The blood is also subcultured onto agar plates to isolate the pathogenic for culture and suceptibility testing, (3 days).
- Identifies the species of bacteria.
- Antibiotic sensitivities are then assessed on the bacterial isolate to inform clinicians on appropriate antibiotics for treatment.


B
D

- **The following criteria may be helpful in differentiating "true positives" from contaminated specimens:**
- (1) Growth of the same organism in repeated cultures obtained at different times from separate anatomic sites strongly suggests true bacteremia.
- (2) Growth of different organisms in different culture bottles suggests contamination.
- (3) Growth of normal skin flora, in only one of several cultures suggests contamination. Growth of such organisms in more than one culture enhances the likelihood that clinically significant bacteremia exists.
- (4) Organisms such as viridans streptococci or enterococci are likely to grow in blood cultures from patients suspected to have endocarditis, and gram-negative rods such as *E coli* in blood cultures from patients with clinical gram-negative sepsis. Therefore, when such "expected" organisms are found, they are more apt to be etiologically significant.
-

Meningitis

Inflammation of brain and spinal cord membranes

Causative agents

- -**In infants** (to 2 months) ---- *E. coli* , *Salmonella* spp. , *Citrobacter* spp.
- -**In all other age groups**

1-Purulent meningitis (CSF is turbid , 100-3000 PMNs / mm3 ----- *H. influenzae*, *N. meningitides*)

2-A septic meningitis (CSF is clear or slightly turbid 10-500 leukocyte / mm3 mostly lymphocytes) ---------- *Cryptococcus neoformans* , *Candida albicans* , Leptospira .

Specimens

CSF 3-5 ml is collected in two sterile tubes

- One for chemical examination (glucose and protein)
- Second one for microbiological examination and leukocytes count.

- **The CSF is sterile , clear and colorless fluid , contains 0-5 leukocyte/ mm3 and no RBCs.**
- -Blood culture should be done because meningitis is often associated with bacteremia .

Microscopic examination

Direct examination for leukocytes (PMNs or lymphocytes) , RBCs , Bacteria , yeasts , motile amoebae.

India ink stain for Cryptococcus (budding) .

Gram stain --- very important because culture depend on its result .

Acid fast stain for tuberculoses meningitis.

Mycology

Mycology is the study of fungi. Approximately 80,000 species of fungi have been described, but fewer than 400 are medically important, and less than 50 species cause more than 90% of the fungal infections of humans and other Animals.

The mycoses with the highest incidence— **candidiasis and dermatophytosis**— are caused by fungi that are part of the normal microbial flora or highly adapted to survival on the human host. Mycoses may be classified as superficial, cutaneous, subcutaneous, systemic, and opportunistic.

Clinical Pathology

Disease: is a pathological condition of a part, organ, or system of an organism resulting from various causes, such as infection, genetic defect, or environmental stress, and characterized by an identifiable group of signs or symptoms.

Pathology: The branch of medicine dealing with the essential nature of disease, especially changes in body tissues and organs that cause or are caused by disease, and it is the structural and functional manifestations of disease.

Etiology: Refer to causes of disease, and contributing factors (Ecological, immunological, physiological).

Pathogenesis: refer to the mechanism of development of disease.

Lesion: is derived from the Latin word laesio meaning injury.

Cellular adaptation:

The changes those are intermediate between the normal cell and the injured cell. The adaptation may be physiological (normal) or pathological (abnormal).

1. Induction of endoplasmic reticulum: Development of more endoplasmic (EPR) due to drug administration over a period of time Ex; increase amount EPR in liver can detoxify many drugs.

2. Atrophy: It is the shrinkage of cell by loss substances or decrease in the size of organ due to decrease in the size of cells.

Causes of atrophy:

a- Decreased workload, Ex; atrophy of muscles of immobilized limbs

b- Loss of endocrine stimulation. Ex; decrease in the thymus in normal aging process.

c- Diminished blood supply; decrease in size of tests, ovaries, as in aging.

d- Inadequate nutrition (insufficient).

3. Hypertrophy: Increased in size of the cells led to the increased in organ size, new cells are not formed, there is enlarged of cell. Hypertrophy involves an increase in intracellular protein rather than cytosol (intracellular fluid). Ex; muscle of body builder. An

example of pathologic hypertrophy is in cardiac muscle as a result of hypertension.

4. Hyperplasia: Hyperplasia is an increase in the number of cells. It is the result of increased cell mitosis, or division. Ex; breast during pregnancy (physiological change) and lactation, thyroid hyperplasia (pathological).

5- Hypoplasia: Failure of an organ to reach full adult size (lung, kidney).

6- Aplasia, Agenesis: Total failure of an organ to develop ex; Aplastic anemia.

7- Metaplasia: Metaplasia occurs when a differentiated cell of a certain type is replaced by another cell type, which may be less differentiated. It is a reversible process thought to be caused by stem cell reprogramming. A prominent example of metaplasia involves the changes associated with the respiratory tract in response to inhalation of irritants, such as smog or smoke.

8- Anaplsia: It is a feature of malignancy, which means cellular pleomorphism, differences in size and shape the nuclei are hyperchromatic (more deeply basophilic staining). ex; sequamous cell carcinoma.

Clinical Pathology

General Mechanisms of Cell Injury

Four intracellular systems are particularly vulnerable to cell injury:

1. Maintenance of the integrity of *cell membrane* (upon which the osmotic homeostasis of the cell is dependent)
2. Aerobic respiration involving oxidative phosphorylation and production of ATP (*mitochondria*)
3. Synthesis of functional and structural proteins (*Golgi)*
4. Preservation of the genetic apparatus of the cell (*nucleus)*

Types of cell injury:

1- Reversible cell injury and degeneration:

Degeneration is changes occur in the cell following injury. The most common reaction to cell injury are, swelling with or without appearance of abnormal substances in the cytoplasm which normally are invisible, absent or present in small amount. The degeneration is termed according to the nature of abnormal accumulated substances as albuminous, fatty, watery…..etc. They may still be reversible if the nucleus remain unimpaired and the injurious agent is removed or destroy before nuclear damage (changes are found in the cytoplasm may be reversible).

Types of reversible degeneration:

a. **Cellular adaptation:** in acute infection or poisoning is the most common type of acute degeneration. In the Microscopic Section (M/S) cells appear swollen, outlines may not be clear; there is damage to the plasma membrane and disruption of mitochondria. Best seen in parenchymal cells of heart, kidneys and live

b. **Hydropic degeneration:** great cellular swelling due to highly absorption of water by the cell. M/S: Fine or coarse vacuoles in the cytoplasm. Best seen in epithelial cell of tubules of kidneys.

c. **Fatty changes:** accumulation of fat in the cytoplasm. Often seen in liver, kidney and heart.

d. **Hyaline degeneration:** Structure less, smooth, homogenous, glassy appearance and stain pink with hemotoxilin.

e. **Amyloidosis:** Paroteinaceous material that accumulate extracellularly in tissues and organs.

f. **Mucinous degeneration:** Ex: catarrhal inflammation-epithelial tumor cells.

Mucoid degeneration: Changes that occur in connective tissuediffer from mucinous degeneration. By higher sulfur content.

Lec 9

Serological tests of some Infectious & autoimmune diseases

A-Infectious diseases

^^^^Ricktettsia

Rickettsia: is a genus of Gram negative bacteria, endospore, highly pleomorophic that can present as cocci ,rods or thread-like, obligate intracellular parasites. Thus, *Rickettsia* cannot live in artificial nutrient environments and is grown either in biological tissues or embryo cultures (typically, chicken embryos are used).

Pathogenesis: *Rickettsia* is transmitted by the bite of infected ticks or mites or by the feces of infected lice or fleas. From the portal of entry in the skin, *Rickettsia* spread via the bloodstream to infect the endothelium and sometimes the vascular smooth muscle cells. Please see the image below of Rocky Mountain spotted fever.

Ricktettsia: can be divided into three groups according to serological basis:

1- Spottd fever group. (Rocky Mountain spotted fever***) Rickettsia rickettsii***

2- Typhus group (epidemic typhus). ***Rickettsia prowazekii***

Murine typhi, endemic typhus. ***Rickettsia typhi***.

3- Scrub typhus group. ***R. tsutsugamushi***.

Serological diagnosis:

A) Weil-Felix Test (classic, low sensitivity & specificity): an agglutination test for various rickettsial infections using particular strains of bacteria of the genus *Proteus* that has antigens (OX 19, OX 2, and OXK) in common with the *Rickettsiae* to be identified.

B) Indirect Immunoperoxidase (IIP) & ELISA

C) Immunofluorescence

D) Western blotting (Immunoblot): A gel electrophoresed and electroblotted antigents**.** It is especially useful **in differentiating true-positive from false-positive results** created by cross-reacting antibodies. Please see the right image above.

Infectious mononucleosis (**IM**; and sometimes called as the **kissing disease** from its oral transmission) is an infectious, widespread viral disease caused by the Epstein –Barr virus(EBV).Typical features of infectious mononucleosis include fever, sore throat, fatigue and swollen lymph glands. Most people are exposed to the virus as children, when the disease produces no noticeable or only flu- like symptoms.

Diagnostic tests.

1**- The monospot rapid latex agglutination test**:

The test detects heterophiles antibodies produced by the human immune system in response to EBV infection. Please see the image below.

Viral capsid antigen VCA and early antigen antibodies appear in the first months of symptoms and are indicative of acute IM, while VCA IgG and EBV nuclear antigen antibodies EBNA appear much later in the course and during convalescence.

2- Indication of detecting antibodies against different EBV antigens via other serological tests:

IgM EA few

Table 1: Progression of Epstein Barr Virus Serological Markers

Infection status	EA	VCA IgM	VCA IgG	EBNA
No prior infection	-	-	-	-
Early infection	+	+	+ / -	-
Late infection	-	- / +	+	- / +
Past/Latent	-	-	+	+

ملاحظة/ روابط الشرح في نهاية المحاضرة

Inflammation:

Is part of the complex biological response of body tissues to harmful stimuli, such as pathogen, damaged cells, or irritants. Inflammation is a protective response that involves immune cells, blood vessels, and molecular mediators.

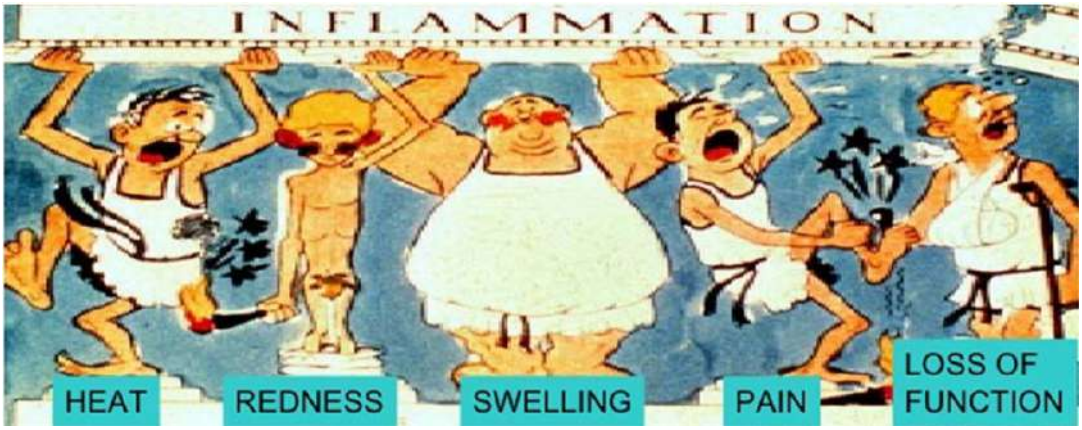
Causes of inflammation are Physical, Biological, Chemical and Psychological.

Classification of inflammation: bases on the duration can be classified into: **Acute, Sub acute and Chronic.**

1- **Acute inflammation**: Acute inflammation is a short-term process, usually appearing within a few minutes or hours and begins to cease upon the removal of the injurious stimulus. It is characterized by exudation of fluid and plasma protein and the emigration of predominantly neutrophilic leucocytes to the site of injury.

It is characterized by five cardinal signs:

1- **Redness** due to dilation of small blood vessels within damaged tissue.
2- **Heat** due to increased blood flow at body core temperature to the inflamed site.
3- **Swelling** is caused by accumulation of fluid.
4- **Pain** is due to the release of chemicals such as bradykinin and histamine that stimulate nerve endings.
5- **Loss of function has multiple causes.**



Process of acute inflammation:

1. Vasodilation:
- The reactions of blood vessels
- Alterations in vascular caliber (diameter)
- Causes decrease in blood pressure

2. Vascular leakage and edema:
- The accumulation of fluid and proteins of plasma in the extravascular tissues (interstitium).

Exudates: inflammatory edema fluid, highly protein content and highly cell count, low glucose content, sometime clots due to fibrinogen content. Its function is to dilute toxins, brings various types of Abs, and limitation of some infection.

3. Leukocyte emigration to extravascular tissues

Morphologic patterns of acute inflammation: On the basis of type of exudates, inflammation is divided into:

1- Serous Inflammation:
The hallmark of serous inflammation is the accumulation of a thin, protein-free fluid derived either from the blood plasma (i.e. *exudate*) or from mesothelial cells (termed *effusion*). Blisters, Serous inflammation is typical of burning and viral infections (Herpes).

2- Fibrinous Inflammation:
In fibrinous inflammation the increase in vascular permeability is greater than in serous inflammation. In fact, we have a protein rich exudate which contains among others fibrin. Fibrinous inflammation is characteristic of inflammation in the **pericardium and pleura.**

3- Suppurative inflammation:
This characterized by the formation of **pus,** a cell-rich exudate, (thick inflammatory fluid composed of living and dead neutrophiles and necrotic particles). suppurative inflammation is typical of bacterial infections (e.g.: Streptococci).

4- Catarrhal inflammation:
This is a mild and superficial inflammation of the mucous membrane. It is commonly seen in the upper respiratory tract following viral infection where mucous secreting glands are present in large numbers ex: **Rhinitis.**

5- Pseudomembranous inflammation:

An acute inflammation response to a powerful necrotizing toxin **(such as diphtheria toxin)**, characterized by formation on a mucosal surface of a false membrane composed of precipitated fibrin, necrotic epithelium, and inflammatory leukocytes.

Beneficial of inflammation:

1- Dilution of toxins.

2- Entry of Antibodies

3- Drug Transport

4- Fibrin Formation

5- Delivery of Oxygen and Nutrients

6- Stimulation of immune response

Harmful of inflammation:

1- Digestion of Normal Tissues.

2- Swelling

3- Inappropriate Inflammatory Response. Hay fever, **pollen extrinsic asthma.**

2- Chronic inflammation: An inflammation that may begin with a relatively rapid onset or in a slow, insidious, and even unnoticed manner; tends to persist for several weeks, months, or years; and has a vague and indefinite termination.

Causes of chronic inflammation:

1- **Persistent** injury or infection
– Ulcer, tuberculosis
2- **Prolonged** exposure to a toxic agent
– Pulmonary silicosis (silica in the lung)
3- **Autoimmune disease**—self-perpetuating
Immune reaction that results in tissue damage and inflammation
Rheumatoid arthritis

Systemic lupus erythematosus

Multiple sclerosis.

Types cells of chronic inflammation:

1- Histiocytes or tissue macrophages:

They appear in the late stage in acute inflammation and in most types of **chronic** inflammation. They phagocytose the necrotic tissues and debris in order to prepare the inflamed area for the process of repair.

2- Lymphocytes: They are of two types, **T lymphocytes** which produce cytokines in acute inflammation and **B lymphocyte** which upon antigenic stimulation transform into plasma cells which produce **antibodies.**

3- Eosinophils: It is a type of white **blood** cells which appear in large number in allergic and parasitic inflammations

4- Giant cells: They are large cells with multiple nuclei. They phagocytose the large foreign particles.

5- Fibroblasts: They are cells which produce collagen fibers and lead to repair by fibrosis in **chronic** inflammation. It also plays a role in the process of repair and healing.

Granulomatous inflammation:

A granuloma is a microscopic aggregate of epithelioid cells, which is an activated macrophage, with a modified epithelial cell-like appearance (hence the name epithelioid). The epitheloid cells can fuse with each other and form multinucleated giant cell. Which are two types:

1- Foreign body-type giant cell: have irregularly scattered nuclei.

2- Langhans giant cell: nuclei are arranged peripherally in a horse-shoe pattern seen in tuberculosis.

Healing: It is the process by which the cell in human body regenerates and repairs to reduce the size of a damaged or necrosis area and replace it with new living tissue. The replacement can happen in two ways:

By *regeneration* in which the necrotic cells are replaced by new cells that form similar tissue as was originally there; Or **by *repair* in** which injured tissue is replaced with scar. Most organs will heal using a mixture of both mechanisms.

Factors influencing healing process:

1- State of nutrition Vit.C and D essential in bone healing.

2- Administration of cortisone depress the formation of granulation tissue.

Regeneration:
In order for an injury to be healed by regeneration, the cell type that was destroyed must be able to replicate. Cells also need a collagen framework along which to grow. Alongside most cells there is either a basement membrane or collagenous network made by fibroblast that will guide the cells' growth.

Repair: When there is tissue loss, healing by proliferation of connective tissue resulting in fibrosis and scar formation.

https://youtu.be/fHLlZ09uI_Q

https://youtu.be/3NOdjhzTs_I