INTRODUCTION TO PATHOLOGY

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Definitions: **Blue**.
Examples: **Green**.
Important: **Red**.
Extra explanation: Gray.
Diseases names: Underline.

WHAT'S PATHOLOGY?

Pathology: (pathos) disease , (-ology) study. (The study of a disease). It is the study of changes which occur in cells and tissues as a result of any injury to the cell or tissue.

Etymology is the origin or root of the word. Many medical terminologies are derived from smaller words called origins. For example: phagocytosis could be divided to the following origins: phago: means to devour (eat) , cyto: means cell, sis: means the process of. Together they give the meaning which is the process of eating cells.

Disease: a dysfunction (psychological, physiological, anatomical). It can be caused by an obvious structural abnormality (e.g. **broken bone, tumor**[1]) OR it can be less defined (e.g. **anorexia** [2]**nervosa**).

1. **Physiological Dysfunction**: a patient with pain in his abdomen, the symptoms could be: mass, pain or bleeding in his abdominal region.

2. **Psychological Dysfunction** :
when you examine the patient and you find nothing wrong with his body, but when you talk to him he says: "يادكتور أنا كل يوم أسبح مع الجن وأحس في مؤامرات علي لأنهم يغاروا مني"
Anorexia nervousa: a psychiatric illness in which patients starve themselves or use other techniques, such as vomiting ot taking laxatives[3], to induce weight loss. (to loose weight) .
* we study this disease in neurology [4]and psychiatry[5].

All diseases have certain aspects that can form the basis of a classification & these include:
1- **Epidemiology:** refers to sex (gender), prevalence, incidence, and geographic distribution of the disease.
2- **Etiology:** is the direct cause of the disease.
3- **Pathogenesis:** is the mechanism [6]of the disease production.
(Squamous Metaplasia [7]→ Dysplasia [8](pre cancer) → lung Cancer)

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[1] ورم
[2] فقدان الشهية
[3] أدوية مسهلة (ملينات)
[4] طب الأمراض العصبية
[5] الطب النفسي
[6] آلية
[7] Abnormal **development** or **growth** of tissues, cells or organs
[8] Transformation of cells from normal to an abnormal state

Branches of Pathology:

Branches of Pathology

- **Histopathology** — The study of tissues under the (subsequently stained and examined) . Tissues are obtained by biopsies.
  frozen section: processing the tissue rapidly to give results in 20 min during surgery.
- **Cytopathology**
  - **exfoliative cytology:** Collecting detached or exfoliated cells from the surface of an organ like:
    (Uterine cervix – bronchial tree – oral mucosa)

    
  - **Fine-needle aspiration cytology (FNAC) :** The suction of cells from diseased organ by a needle.
    E.g. sputum, cerebrospinal fluid, urine, effusions in lung abdomen, wall of cervix.

    
- **Hematology** — study of the constituents of blood and bone marrow, used in the diagnosis of anemias & leukemias.
- **Immunohistochemistry** — a specialized staining procedure is used to detect antigens in the tissue.
- **biochemistry** — the analysis of bodily fluids (blood, urine, etc) for diagnosis.
- **Microbiology** — the study of micro-organisms.
- **Immunology** — the analysis of the immune system of the body.
- **Molecular techniques** — various molecular techniques such as fluorescent in situ hybridization, Southern blot are used to detect genetic diseases.
- **Toxicology** — study of various poisons and toxic substances.
- **Cytogenetics (clinical genetics)** — study of chromosomal abnormalities.
- **Autopsy**

Immunology: Antibodies + Antigens. (How they act and produce diseases): specific responses to foreign organisms or material.
Antibodies: a special king of blood protein that is synthesized in lymphoid tissue in response to the presence of a particular antigen. It circulates in the plasma to attack the antigen (Defender).
Antigen: any substance that could be bound (attacked) by an antibody (Trouble source).

Epidemiology

Epidemiology: Study of the occurrence [9]and distribution [10]of diseases or events in specified populations regarding: (age, sex, location, Prevalence, Race, Occupation) .

Epidemic[11]: a sudden outbreak of infectious disease that spreads rapidly and affects a large population of people. (**Influenza**)
Endemic: a disease occuring frequently [12]in a *particular region or population*. (**malaria is endemic in Africa**)

Morbidity: a measurement of *sickness or disease* within a geographical location.
Mortality: the number of *deaths* cases within a geographic location.

- **Diseases for certain gender:** Some diseases affect only females or only males.

Example: If a female has a difficulty in urination, we don't say that she has an enlargement in the prostate (only in male) .
* a physician should think of the most common diseases first and rule them out before considering rare diseases. For example, when a female comes with a blood clotting problem, hemophilia shouldn't be the first thing to come up as a diagnosis because it is very rare in females.

- **Diseases for certain age:**

* Always ask the age to exclude[13] the non suitable diagnosis.
When a young man is having frequent urination we shouldn't think of prostate cancer directly as it usually affects older men.

- **occupation:**

Examples:
1. Workers in asbestos industry can have **asbetosis** 9 (related to scars in the lungs) or **mesotheliomas (**malignant tumour [14]of the lung pleura) .
2. Workers in aniline dye [15]industry can have **urinary bladder cancer**(transitional epithelium → squamous metaplasia) through the effect of chemicals.
3. **nasal [16]cancer** as a result of inhalation of wood dust in hardwood manufacturing.

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[9] وجود
[10] توزيع
[11] A lung disease resulting from the inhalation of asbestos particles.
[12] بشكل متكرر
[13] استبعاد
[14] ورم خبيث
[15] صبغة الألنين (سائل زيتي سام)
[16] أنفي

- **Prevalence:** the total number of cases in any time. Meaning that this disease is always present in this place.

Example: tuberculosis and **Diabetes mellitus** are prevalent in Saudi Arabia; they are found througout the year and have been here for a long time.

- **Incidence:** restricted to period of time & geographic region.

Example: during last Hajj period, there has been an increased incidence of **influenza** virus because it was crowded in Mecca.

*__Epola virus__ is incedent in Africa while __malaria__ is prevalent.

Factors which affect *incidence* and *prevalence*:

1. **Time:** how the disease has varied over the course of time.
2. **Place:** how the disease varies geographically.
3. **Person:** the difference between a person who suffer from a disease and other who does not.

- **Geographic region.**

Example: patient from Bangladesh with **fever** said: "I have a fever that comes and goes for two months". We should consider that he has **tuberculosis**. 80% of the case you could be right, because this disease is prevalent in Bangladesh."

* If he comes from a different part of the world, then the statistics change and I might think of another disease that is common in that part of the world.

Now we know the importance of epidemiology in diagnosis; it helps us to execute some diseases since some diseases related to gender.
Example: **Prostate** which occurs only in males. Some disease affect old people while it can't affect youngstes.

Etiology

Etiology: cause of disease (bacterial, fungal, parasternal, environmental, metabolic) .
Note that it may be written "aetiology" and it is the same thing.

Idiopathic Diseases [Essential, Primary, Cryptogenic [17]and Spontaneous diseases]: a disease with unknown cause.

- Disease may be **environmental** (or behavioral). (Diseases resulting from chemicals, smoking, getting run over by a bus…)
- Diseases may be **genetic**; the environment has no role in this disease. (**Trisomy 21** or **Down syndrome**)

Note: some diseases may results from an **environmental** factor in conjunction with a **genetic** predisposition (problem).
When looking at patients with **vitiligo** [18]or **albinism**, there is no –or little- melanin stain in the skin. This isn't a problem by its self, but it makes the patient more susceptible [19]to other diseases such as **skin cancer**.

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[17] مجهول السبب
[18] البهاق
[19] أكثر عرضة

Pathogenesis

Pathogenesis: mechanism of disease occurrence (steps of the disease to occur), a process with stages. Example: lung cancer develops for years. Stages: Smoking -> irritation for the bronchial mucosa (lined with ciliated columnar epithelium) -> chronic inflammation [20]-> (Metaplasia) Transformation of ciliated columnar to squamous -> (dysplasia) squamous transformed into pre-cancerous cells -> cancer -> death.

Classification of diseases according to their pathogenesis:

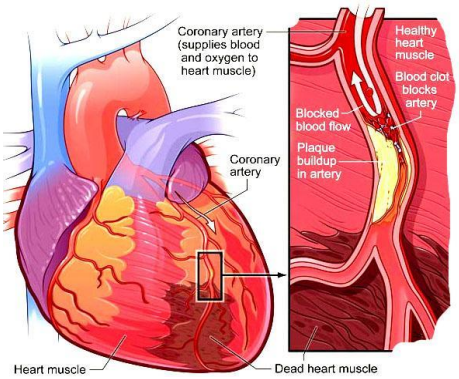
Type	Basis	Examples
1. Congenital	**Genetic**	Reduction or absence of blood clotting factor VIII leads to **hemophilia** A (X chromosome linked) .
	Non genetic	**Cleft [21]lip and palate[22].**
2. Acquired	**Inflammatory**	- Dermatitis (**eczema**, inflammation of the skin) - **Rheumatoid disease** (inflammation of joints /**arthritis**[23]).
	Vascular	**Atherosclerosis** (deposition of lipid with thickening of blood vessels) leading to a cerebrovascular accident (stroke , myocardial infarction (heart attack) .
	Growth disorder	**Cancer**.
	Degenerative	**Alzheimer's** disease, **Parkinson's** disease.
	Drug induced	Bone marrow suppression, skin rashes, renal failure.
	Infective	Viral, bacterial or fungal diseases.
	Metabolic	**Gout**: deposition of uric acid crystals in joints and tissues. **Diabetes mellitus**: abnormal metabolism of carbohydrates and lack of insulin. **High uric acid.**
	Nutritional deficiency diseases	**anemia**, **protein-energy malnutrition**.

Remember: not all congenital diseases are genetic: **Down syndrome** and **cleft palate** are both congenital, but the first (Down syndrome) is genetic, and the second (cleft palate) is non-genetic.

[20] التهاب مزمن
[21] شق
[22] أعلى الفم
[23] التهاب المفاصل

CLINICAL CASES

Myocardial infarction



Cardiovascular disease

50 years old man with central chest pain.

The doctors suspects he has myocardial infarction (ذبحةقلبية) "why?"

1- Because this symptom is very common.

2- This case is the most common in his age.

Pathogenesis: High cholesterol > thrombosis جلطة > coronary arteries clot تجلط الشرايين القلبية (they supply blood to heart) > heart doesn't get blood needed > ischemia (poor blood supply to an organ or part of the body, especially the heart muscles.) > Hypoxemia نقص الأكسجة > severe pain (60% die) .

Eczema

Inflammatory disease.

Example: my hand is always red and feels hot.

He could be: allergic / inflamed / infected.

He says: I bought nylon socks and after wearing them my hand got red & "فيهاصديد"

He has: **eczema** / dermatitis (allergic)

Cleft palate

Congenital Malformation.

boy with a **cleft palate.** (congenital malformation)

Treatment: surgery.

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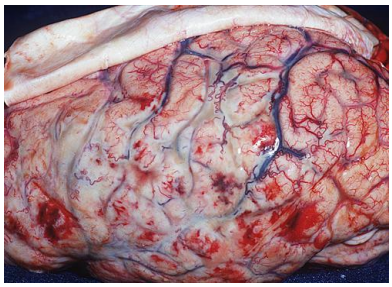
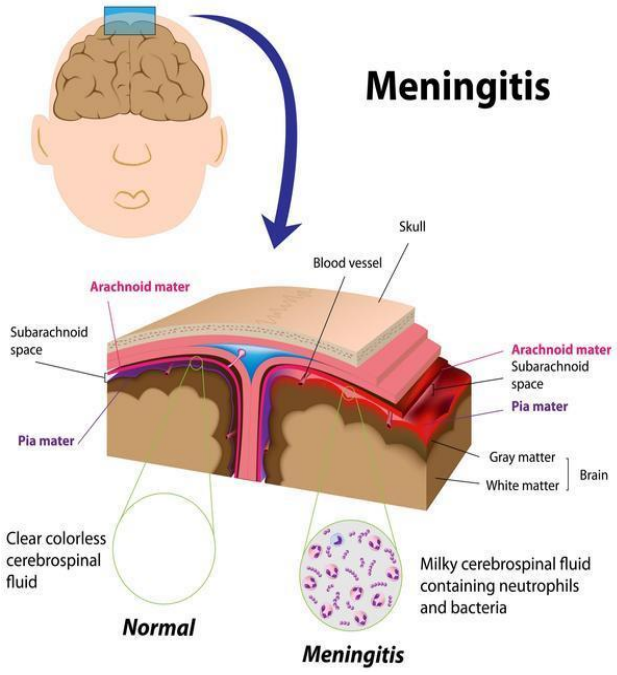
meningitis

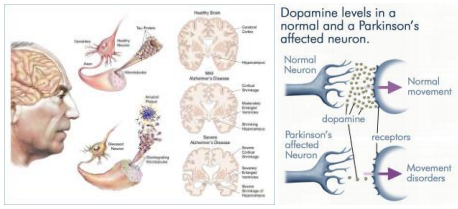
Man with bacterial التهاب السحايا **meningitis** (16 years)

Symptoms: headache, high body temperature [39.5], stiff neck, fear of light (photophobia) .

Diagnose: acquired inflammatory. **Cause**: bacteria.







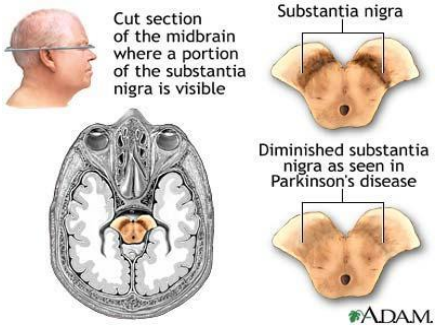
Dementia or Alzheimer's

80 years old man يروح يصلي كل يوم ومرة مارجع بعدين اتصلوا الشرطة على أهله وقالوا انه ضايع مايعرف وين بيته وموعارف يرجع):

This man has **dementia** or **Alzheimer's**: doesn't remember near memories and remembers remote memories.

Causes: caused by degeneration of the hippocampus area cells (atrophy of brain).

Diagnose: Degenerative diseases.



Parkinson disease

Signs: 80 year old, has no expression on his face, hands are shivering. "رجفان"

Degeneration of neurons in the substantia nigra in the brain stem (neurons have pigments).

Gout

Acquired (inflammation)

Works at a company + eats meat a lot

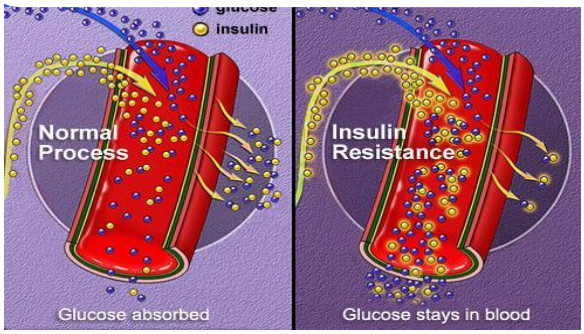
Sign: Swollen toe

Error in purine Metabolism > increase uric acid > crystals "*بلورات*" > enjoins "*تتراكم*" > pain

Diagnose: **Gout**, (metabolic).

Diabetes

Diabetes mellitus: (metabolic) –acquired from bad habits-[partly genetic / partially environmental].



hemorrhagic skin rash

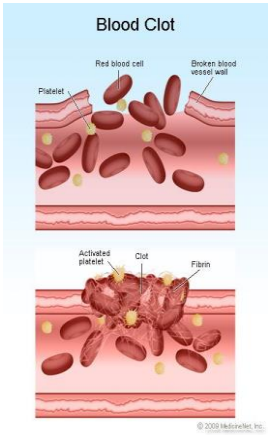
- Girl with sore throat "doctor gives her antibiotic". After taking pills she suffers from (hemorrhagic skin rash)
- Drug induced (toxicity) can cause diseases in liver/kidney/lungs/mostly rash.
- Ask about the history to know which drug he has taken -acquired- drug induced.

Hemophilia

Man with swelling contains blood

Symptoms: said: "I've always had excessive bleeding. Me and my brother. But my sister doesn't".

Diagnose: problem is physiological (organic) + related to blood coagulation (blood tendency) + inherited + deficiency of factor 8 (coagulation factor) [we have 12 factors] + the gene for it is mutated or absent = **Hemophilia**.



down syndrome

Congenital (Genetic / chromosomal)

Boy that isn't doing well at school.

Symptoms: slanting eyes, short neck, short structure, one crease in the palm of the hand.

Diagnose: down syndrome (21 trisomy shown by karyotype) .

How to a study disease?

Ways of thinking about a disease :

1. **Definition**: Clinical or Pathological.
2. **Epidemiological**: Incidence, Age, Gender, and Geography.
3. **Clinical Presentation**: **Symptoms** (Patient's complaint), **Signs** (Clinical features after examination).
4. **Underlying Pathology**: Understanding the mechanism of a disease:
    a. Changes in tissue visible with naked eye (**Macroscopic**).
    b. Changes seen only under microscope (**Microscopic**).
    c. Tissue function (**pathophysiology**).
5. **Differential diagnosis**: Other similar diseases.
6. **Treatment and Management**: Drugs, Surgery, counseling.
7. **Prognosis:** History of the disease and the likely outcome.

Diseases are discussed in terms of morbidity and mortality. Survival rates are expressions of the disease outcome e.g. in some types of lung cancer, the 5-year survival rate is 0%.

The Diagnostic Process:

Symptoms and Clinical Examinations show signs to make a diagnosis. Examination of specimen (Urine, Blood …etc.) are efficient in confirming the diagnosis and monitoring treatment.

a) Diagnosis involves clinical skills and lab (Tests).
b) Pathological techniques aid in diagnosis.

Diagnosis: Identifying a disease in a patient, based on history, examination, and investigation.

Making a diagnosis involves:

1. Taking clinical history of symptoms.
2. Clinical examination for signs.

The clinician then works through a series of questions:

Which organ system is affected? Which category of disease do signs and symptoms suggest?

Other factors, such as: (age, sex, habits) that provide clue to the diagnosis.

The diagnostic process involves testing a series of *hypotheses* based on:

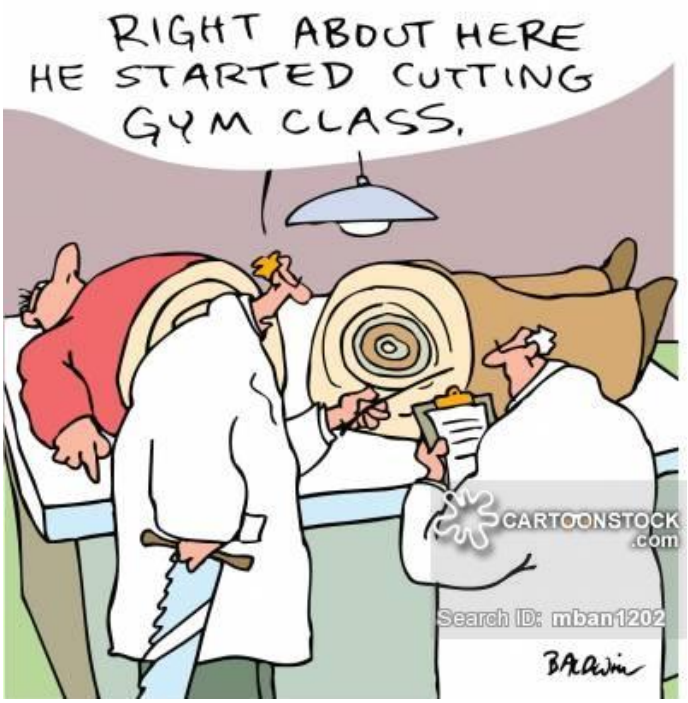
- Knowledge of the frequency of occurrence of the symptoms and signs in *different* diseases.
- And upon the *probability* of the occurrence in the patient's population.

A list of possible diagnosis is constructed (Differential Diagnosis), starting with the most likely disease, and processing to diagnosis which are less likely but important to exclude.

Reaching the diagnosis enables the clinician to start treatment and give the patient an idea of the outcome (Prognosis).

Autopsy

Autopsy: The Anatomy after death. **Synonyms:** (**Necropsy** and **Postmortem**).



Aim of Autopsy:

1. Determine the cause of the death. (C.O.D.)
2. Confirm a clinical diagnosis.
3. Teaching (Students see an actual sample of disease).
4. Research.

What Does a Pathologist Do?

The pathologist can help the clinician to make a diagnosis by looking at sample of tissue (known as biopsies) .Pathologist also perform autopsies.

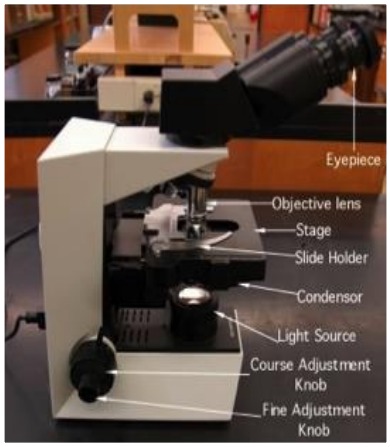
Techniques in Histopathology

Basic histological techniques involve:

1- The fixation.
2- Processing of biopsied (excised tissues).
3- Finely sliding to a thickness of no more than 4-5 microns (µm).
4- Staining on a glass slide.

Some of the instruments used in pathology:

Light Microscope



Immunofluorescence Microscope

Uses a special blue filter to search for various antigens in a tissue with the help of a fluorescent dye. It helps in diagnosing *immunological* diseases.

Electron Microscope

Uses electrons to magnify objects up to *two million* times. It enables us to see cell structures to the level of individual cellular organelles like: mitochondria, nuclei, & also you can see viral particles. known as *ultrastructural examination*.

MCQ's

1-Fine-Needle Aspiration Cytology (FANAC) is one of the methods of?
a) Cytopathology.
b) Autopsy.
c) Cytogenesis.
d) Biopsy.

2- "Incidence" refers to?
a) The number of new cases of diseases.
b) The total number of cases of diseases.
c) The expected outcome of the disease.
d) The presence and extent of illness.

3- A tissue sample from a living person is called?
a) Autopsy.
b) Biopsy.
c) Microbiology.
d) Cytopathology.

4- Congenital diseases exist exclusively in?
a) Chromosomes.
b) Birth or during first months of life.
c) Adults.
d) Elderly.

5- Also called as Ultra Structural Studies?
a) Electron Microscope.
b) Light Microscope.
c) Immunofluorescence Microscope.
d) Dark Microscope.

6- The correct sequence of the natural history of disease is:
a) Latent period, exposure, outset of disease, outcome of disease.
b) Exposure, latent period, outcome of disease, outset of disease.
c) Exposure, latent period, outset of disease, outcome of disease.
d) Latent period, exposure, outcome of disease, outset of disease.

7- Ultra structural examination requires?
a) Light microscope.
b) Ultrasound.
c) Electron microscope.
d) X-ray.

8- People who suffer from Parkinson disease are usually in the age of?
a) 80s.
b) 60s..
c) 20s.
d) 40s

9- Hemorrhagic skin rash is caused by?
a) Food ingestion.
b) Drug induction.
c) Microorganisms.
d) Cell injury.

10) Gout is considered a:
a) Drug induced disorder
b) Genetic disorder
c) Acquired disorder
d) None of the above

11) Meningitis is caused by:
a) Degeneration of brain cells
b) A metabolic disorder in the joints
c) Congenital disorders
d) None of the above

1: a
2: a
3: b
4: b
5: b
6: c
7: c
8: a
9: b
10: C
11 d

For any questions and suggestions:
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Good Luck!!

Pathology team:

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ريما الرشيد
ريما هزازي
شهد القحطاني
شيماء الدعيجي
نورة الهلالي

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