

INTRODUCTION TO PATHOLOGY

Objectives:

- Understands the role of pathology and its various subspecialties in the diagnostic process with special emphasis on histopathology and cytology.
- Understands the meaning of the terminology used during the study of a disease like aetiology, pathogenesis, prognosis, sequelae, symptoms, signs, incidence etc.
- Role of diagnostic pathology in disease management.
- Be aware of some of the principle techniques used in pathology like light microscopy, cytology, immunohistochemistry and molecular pathology.
- Have a basic knowledge of the definition of autopsy and its indications.

Color Index:

Girl's Slides

Important

Male's Notes

Female's Notes

Extra information

Definition of Pathology

Pathology

The study of **disease** by **scientific methods**. It is the study of changes which occur in cells and tissues as a result of any injury to the cell or tissue.

Disease: An abnormality in structure or function of any part of the body.

A disease can be **physiological** or **psychological** or **both**

Parts of Pathology

1- Epidemiology

2- Etiology

3- Pathogenesis

4- Morphologic changes

5- Clinical features

Signs

Symptoms

Mnemonic: My Cat Plays Every Evening

1- Epidemiology

Definition

Study of the **occurrence** and **distribution** (**Demographic** of diseases in a population) and the application of this knowledge to help the health system. It is the study of the patterns, causes, and effects of disease conditions in various populations.

Factors in epidemiology

Age

Sex

Occupation

- hardwood workers → nasal cancer (from inhalation of wood dust etc.)
- aniline dye industry → urinary bladder cancer.
- workers in asbestos industry → asbestosis or tumors like mesotheliomas.
- Dentist → Back Pain

Geographic location

Which Part of the world a particular disease is common in.
 I.e. Which country has more prevalence?
 Underdeveloped countries → malnutrition and infections like TB.
 Developed countries → cardiac problems and obesity.

Race

Socioeconomic strata

what is the **social** and **financial** status of the people affected by a particular disease.
 i.e. Rich → nutritional Diseases e.g. Diabetes.
 Poor → Infectious Diseases e.g. TB.

Sequelae

Complications/ Consequence of the disease,
 Word origin: "Sequence of events".
 E.g. Scars

Prognosis

expected **outcome** of the disease based on its severity.
 Bad prognosis → High grade cancer
 Good Prognosis → Common cold

Prevalence

The **total number of cases** of a particular disease in a particular population in a particular period of time.

Probability of already having a disease

Counts **old and new** cases

E.g. hepatitis B is prevalent in Saudi Arabia.
 E.g. In Saudi Arabia, in 2018, 20 people have diabetes.

Incidence

The **number of new cases** of a disease a particular disease in a particular population in a particular period of time (immunization programmes affect the incidence of a disease).

The probability of developing a disease

Counts **only new** cases

E.g. the incidence of influenza increases during hajj season in Saudi Arabia.
 E.g. In Saudi Arabia, in 2018, 5 **new** people have diabetes.

Morbidity rate: number or percentage of people who **have the disease**. (Presence of an illness)

Mortality rate: number or percentage of people who have **died** in a particular population in a particular period of time.
 E.g. high grade cancer = ↑ Mortality rate
 E.g. In Ksa, in 2017, 2 People died from TB

1- Epidemiology (cont.)

Importance of epidemiology

Investigate the extent of a disease in a community.

Study natural pattern, history, and prognosis of a disease

Identify causes & risk factors of a disease.

Provide good health care based on the findings.

To recommend and assist in various health programmes to prevent or treat a disease (preventive and therapeutic measures), e.g. immunizations and screening programs for different disease etc.

To evaluate all health facilities and programs

Provide information on public health in order to help care system and develop health facilities.

2- Etiology

Definition

- It is the **cause** of the disease.
- If the **cause is unknown**, We call it **idiopathic**/cryptogenic/essential etc.
- Diseases are classified depending on the etiology and pathogenic mechanism involved. **Diseases can be Congenital or acquired.**

Cont. In the next page..

*An inflammation can be caused by an infection **but not always.**

An infection is caused by a foreign organism(bacteria, virus.etc)

Inflammation can be from an autoimmune disease or allergy

Type	Basis	Example
1- Congenital (a condition existing at birth or before birth, or that develops during the first month of life)	<i>Genetic</i>	<ul style="list-style-type: none"> - Hemophilia: absence of blood clotting factor VIII (X chromosome linked) - Down syndrome: extra chromosome 21 - Inborn errors of metabolism
	<i>Non-genetic</i> Abnormal defect or deformity a child is born with, associated with embryogenesis	<ul style="list-style-type: none"> - Cleft lip/palate - Spina bifida
2- Acquired	<i>Inflammatory*</i>	Rheumatoid arthritis: inflammation of joints /arthritis
	<i>Vascular</i>	Atherosclerosis: Leads to: cerebrovascular accident(stroke)/myocardial infarction(heart attack) or immune mediated e.g. vasculitis
	<i>Neoplastic (Growth disorder)</i>	Cancer
	<i>Degenerative</i>	<ul style="list-style-type: none"> - Alzheimer's (Type of Dementia) - Parkinson's
	<i>Drug induced (Therapeutic and Recreational Drugs)</i>	<ul style="list-style-type: none"> - Certain drugs can cause liver or kidney failure, bone marrow suppression & skin rash. - Alcohol can cause liver disease - Paraquat poisoning damages the lungs - Excessive smoking causes lung and cardiac problems.
	<i>Infective</i>	Viral, bacterial, fungal, parasitic diseases.
	<i>Metabolic</i>	<ul style="list-style-type: none"> - Diabetes mellitus: a chronic disease Caused by Error in the metabolism of carbohydrates - Gout: a metabolic disorder caused by an error in the metabolism of urate(uric acid)
	<i>Nutritional deficiency diseases</i>	<ul style="list-style-type: none"> - Anemia - protein- energy malnutrition
	<i>Radiation</i>	<ul style="list-style-type: none"> - Neck: can cause thyroid cancer - Skin: can cause skin cancer (Squamous cell carcinoma)
	<i>Mechanical</i>	<ul style="list-style-type: none"> - Road traffic accidents - burns

3- Pathogenesis

*It is the transformation of Normal cells into Abnormal cells, it helps to target the problem, and drugs are given based on it

Definition

The steps that take place **in the body** once the problem begins, leading to tissue injury (pathological manifestations) & eventually to **morphologic changes** (changes in the gross or microscopic appearance of human tissue).

Pathogenic mechanisms

Four basic pathogenic mechanism (or steps) in a disease

Inflammatory process

Degenerative process

Carcinogenesis
(the transformation of normal cells to malignant)

Immunological process

4- Morphologic changes

Definition

- **Structural changes** that take place in cells or tissues due to any disease. (appearance of illness)
- Diseases commonly have specific morphological changes (gross or microscopic), helping in the diagnosis of the disease.

Types of morphological changes

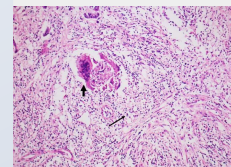
Gross (macroscopic findings):

Can be seen with naked eye.



Histological (microscopic findings):

Can only be seen under the microscope



5- Clinical Features

When an organ is damaged, its normal function will be affected, leading to the development of certain **clinical changes known as signs & symptoms**. (The combination of signs and symptoms is called as **clinical features**).

Symptoms

Something **experienced and reported by the patient** e.g. 'I am feeling tired', 'I have a headache', 'I have a pain in my stomach' etc. Basically it is what the Patient will tell the doctor.

1

Signs

are findings discovered by the physician during examination of the patient e.g. doctor finds a swelling somewhere or doctor find a liver or spleen enlargement while examining the abdomen etc.

Basically it is **what the doctor will find on examining the patient.**

2

PATHOLOGY

Epidemiology

Etiology (The cause leads to the beginning of the pathogenesis)

Pathogenesis

Morphological or chemical alteration

Clinical Features (Signs and Symptoms)

THEREFORE IN MEDICINE, DISEASES ARE STUDIED UNDER THE FOLLOWING HEADINGS

(How you study Pathology):

- Definition
- Epidemiology of disease
- Etiology
- Pathogenesis and pathophysiology
- Morphology: it is divided into
 - Gross/ macroscopic- visible to the naked eye
 - Microscopic- visible under a microscope
- Clinical features/presentation: signs and symptoms
- Differential diagnosis (**Which leads to final diagnosis**): is there any other alternative diagnosis/diagnoses with similar findings?
- Treatment and management
- Prognosis

Steps of studying a disease

1

Define the disease.

example the definition of gout: is a metabolic disorder caused by an error in the metabolism of urate(uric acid).

2

Epidemiology (age,sex,race...etc).

3

Clinical presentation: **Symptoms** (patient complaints) or **signs** (Clinical features discovered by the doctor).

4

Disease location: based on the signs and symptoms you can have an idea of the **organ** or **system** affected by the disease.

5

Testing: either **pathological** tests (biopsy) or **radiological** tests (X-ray).

6

Differential diagnosis: making a list of **all possible diseases** based on the results of tests and on the signs and symptoms

7

Diagnosis: using the test and clinical presentation to diagnose the disease

8

Treatment and Prognosis:

Treatment can be **Surgery, drugs, counseling.**
Prognosis is the predicted **outcome** of the disease.

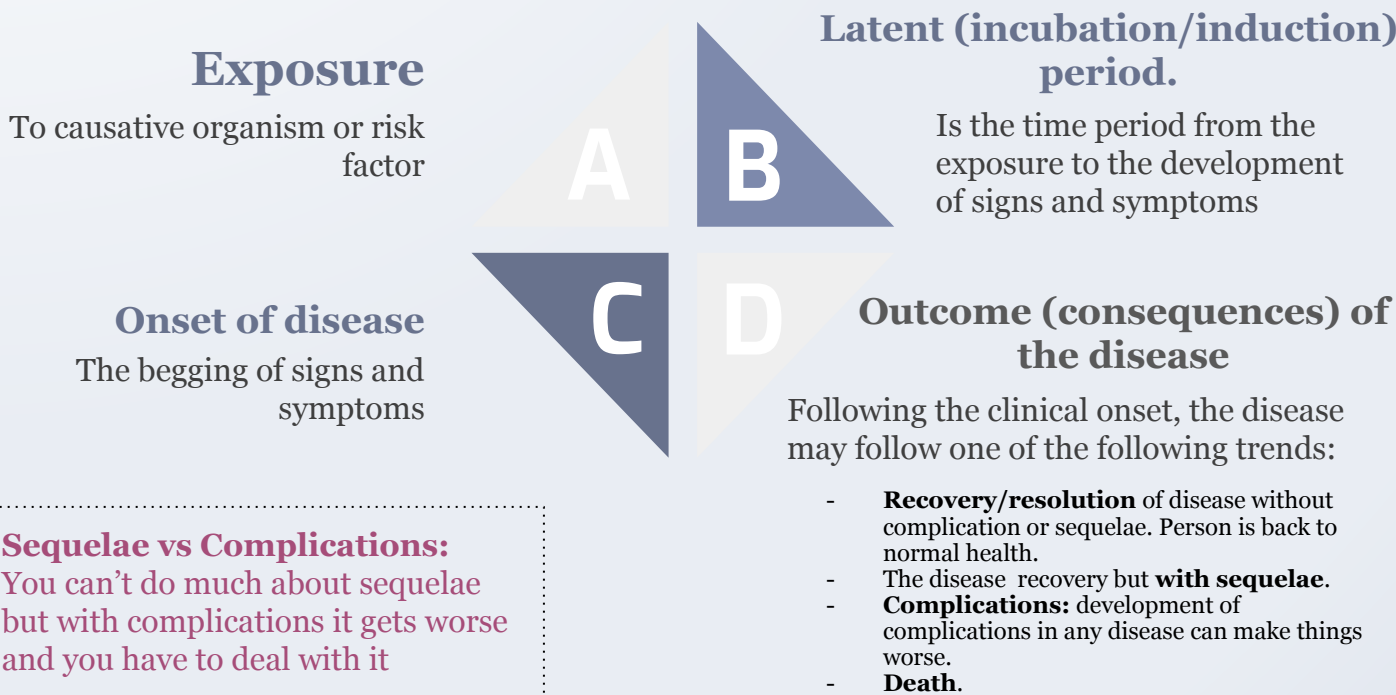
Course Of Disease

- 1) How it starts?
- 2) What happens?
- 3) What does it lead to?

Definition

The course of a disease is **the different stages** in the natural history or **progression** of a disease in the absence of any intervention.

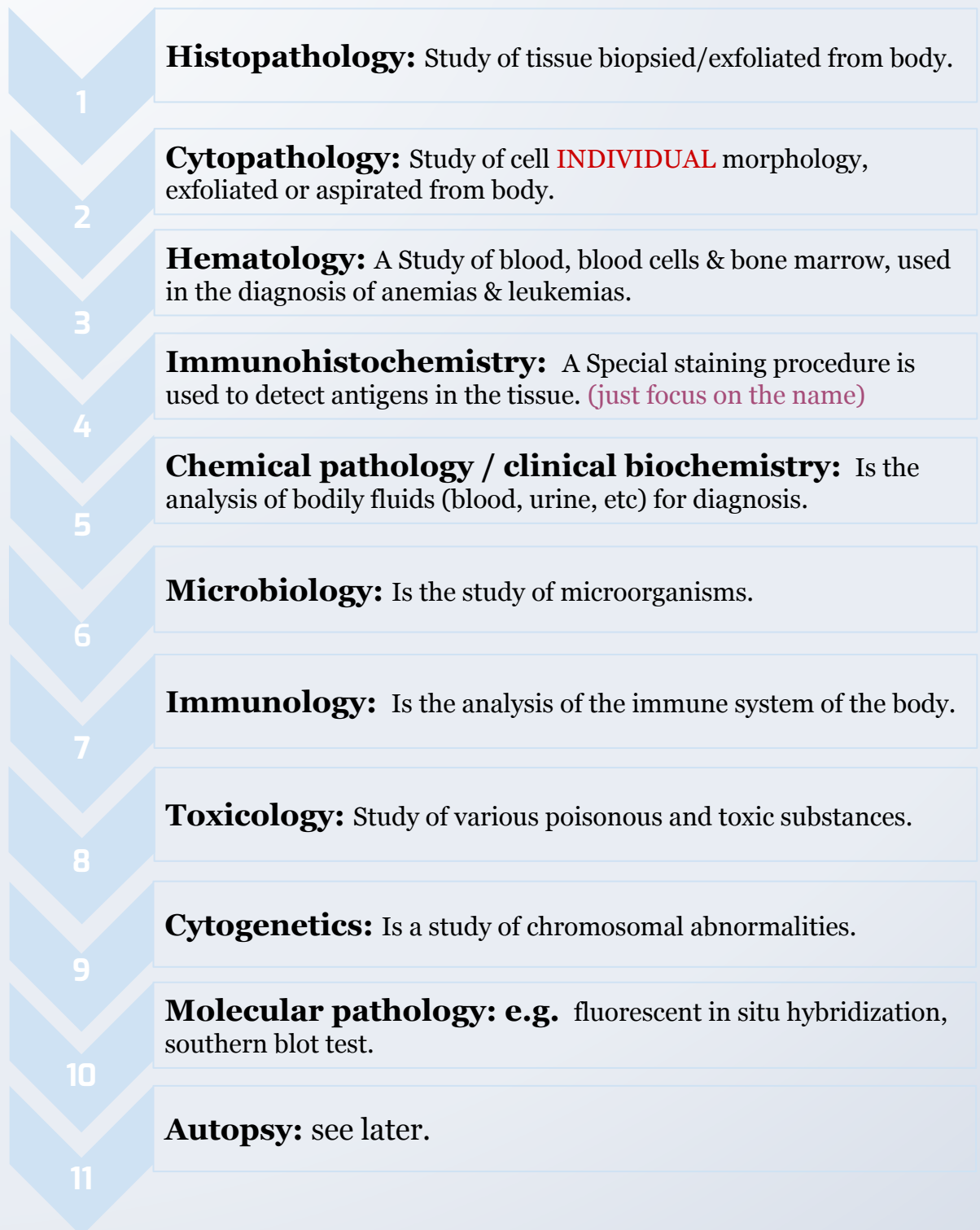
The different stages in the natural history or course of a disease especially infectious are as follows:



The diagnostic process & Role Of Pathologist

- Any patient going to a clinic meets clinician who will take history and do clinical examination. He may ask for radiological and pathological examination in order to come to a diagnosis. **E.g. Doctor comes into differential diagnosis, take biopsy and orders a pathological microscopic examination.**
- The common pathological examinations are blood, urine and stool tests. Sometimes the patient is also asked to undergo a cytopathology or a histopathology test or other special pathological tests in order to obtain an accurate diagnosis.
- This way pathology plays an essential role in the diagnosis of a disease and management and treatment of patient.

The Branches/Subdivisions of Pathology



Histopathology

Histopathology

Is the study of tissues using light microscope. Tissues are obtained by doing biopsies and excision of organs by physicians & surgeons.

- Once the tissue is removed from the patient's body, it is immediately preserved (fixed) by putting it in a container of formalin (10% formaldehyde). The purpose of fixation is to prevent autolysis and decomposition of the tissue.
- Tissue is processed in a special multistep way and the end result is very thin slices of stained tissue (4-6 microns) glued on a slide.

The most commonly used routine stain is Hematoxylin & Eosin stain. It gives the nucleus a blue/violet color & the cytoplasm a pink color.



The pathologist will look at the slide under the microscope and give a diagnosis. Histopathology is usually the final/gold standard of diagnosis.

NOTE: sometimes during surgery an urgent diagnosis is needed INSTANTLY and tissue is processed rapidly to give results in 20 minutes. This is called frozen section. (not the best option, only in Emergency)

STEP 1



STEP 2



Thin Slices of Tissue



SLIDE IS READY



Cytopathology

Cytopathology is the study of morphology of **individual** cells which are obtained by scraping (exfoliative cytology) or aspiration (fine-needle aspiration cytology) from various parts of body.

Fine-needle aspiration cytology (FNAC):

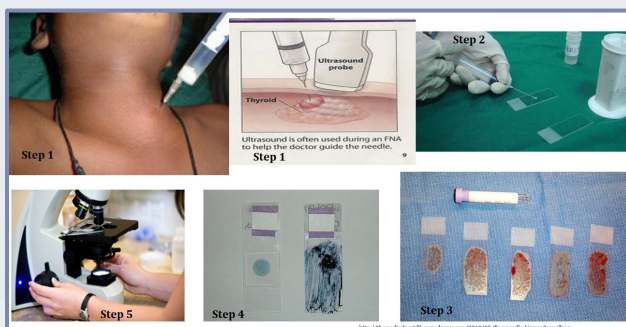
In it the cells are obtained by aspiration/suction of cells from affected organ or tumor mass using a needle. The cells obtained are put on a slide, stained and examined under a microscope.

Exfoliative (falling or scraping off) cytology

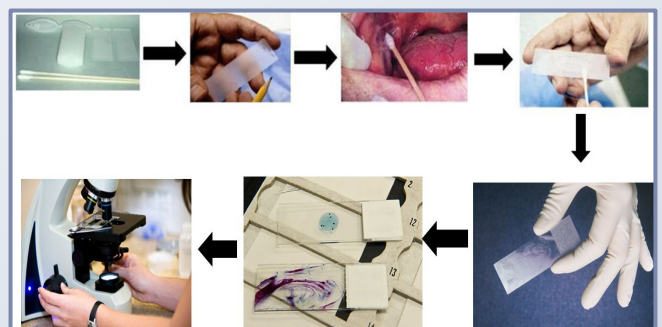
The cells are scraped of any mucosa using a spatula (e.g. cervix and oral cavity) or the cells exfoliate (fall off) themselves and collect in the respective fluids/secretion (e.g. sputum and in urinary tract disease the cells which exfoliate collect in the urine, e.g. **Pap smear**)

- ❖ The morphology of the cells are studied and a diagnosis made from it. It is used for the purpose of:
 - Screening for cancer e.g. cervical cytology is used in the screening of carcinoma of cervix.
 - Diagnosing cancer
- ❖ The advantage of cytologic techniques when compared to histopathological techniques is that the procedure is cheap, takes less time and requires no anesthesia.

Fine needle aspiration cytology (suction of cells)



Exfoliative cytology:



Autopsy

Definition

It is a sub-specialty of pathology which involves examining a dead body

- ❖ An autopsy is done to:
 - To determine the cause of death (this is the main reason why autopsy is done). It can be performed in any of the following situations:
 - ◆ Homicidal
 - ◆ Suicidal
 - ◆ Accidental
 - ◆ To identify the disease
- ❖ To provide useful information about various disease.
- ❖ To do research.
- ❖ Also it can be used as a tool to educate students, surgeons etc
- ❖ Who does the autopsy? The pathologist. (in Homicide forensics does it)

Some instruments in Pathology:

- ❖ There are different diagnostic instruments used in pathology.
- ❖ Some of the instruments used in pathology are:

Immunofluorescent microscope:

uses a special blue filter and a fluorescent dye to identify various antigens in a tissue. It does this by using antibodies tagged with fluorescent dye against tissue antigens. It is used in diagnosing immunological diseases.

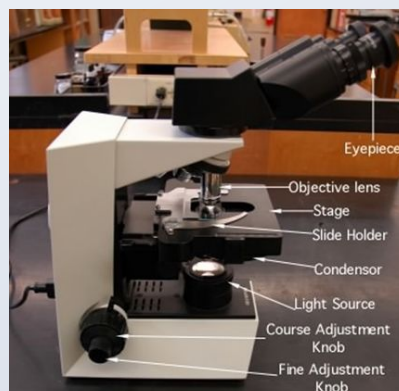


Electron microscope:

magnifies up to two million times, which is much higher than a light microscope. It enables us to see cell structure like mitochondria, endoplasmic reticulum, viral particles etc. It is also called as ultra structural studies. It is an expensive technique.



Light microscope:



Clinical Cases

Hemophilia

Congenital (Genetic)

Symptoms: excessive bleeding.

Caused by: deficiency of factor 8 (coagulation factor) the gene responsible for clotting is absent

(inherited) almost exclusively in males, rarely in Females

while females can only carry and transmit it to the male offsprings

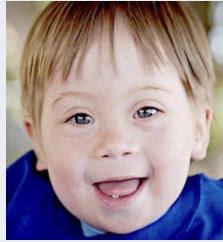
Down syndrome (mongolism)

Congenital (Genetic)

Example of an 8 years old boy:

Symptoms: slanting eyes /cognitive impairment /short neck /short structure /one crease in the palm of the hand / large tongue.

Diagnosis: down syndrome (21 trisomy show by karyotype).



Cleft lip and palate

Congenital malformation (non-genetic)

Example of an boy with a cleft lip and palate

NOT INHERITED

Treatment: surgery



Eczema

Inflammatory disease

Example: my hand is always red and feels hot.

Symptoms: redness ,Swelling ,presence of exudate, pruritus (itch)

Could be caused by:

Allergy /Infection/ Autoimmune disease

He has: eczema/ dermatitis (allergic)

It isn't caused by infection , it's caused by an allergy



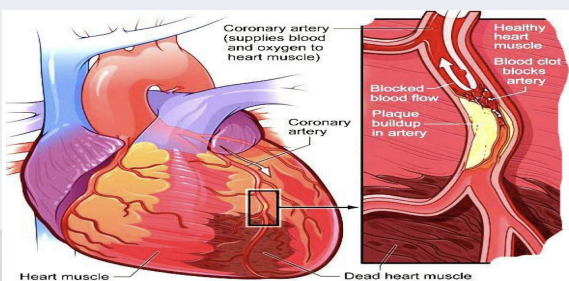
Atherosclerosis:

Vascular disease

one of the major vascular diseases

Caused by: accumulation of lipid in blood vessels that gather and eventually blocks it

Leads to: cerebrovascular accident(stroke)/myocardial infarction(heart attack)



Dementia or alzheimer's

Degenerative disease

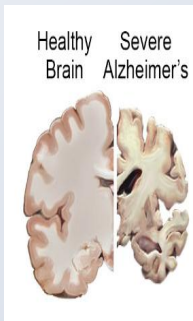
occur in elderly 80-95 years olds

It's a deterioration in the function and structure of cells or tissues because of an aging process

Example: 80 years old man يروح يصلي كل يوم و مرة ما رجع بعدين اتصلوا الشرطة على أهله و قالوا انه ضايع ما يعرف وين بيته ومو عارف يرجع

Symptoms: unable to recall near memories and remote memories/small brain size

Caused by: degeneration of the hippocampus area cells (**atrophy of brain**)



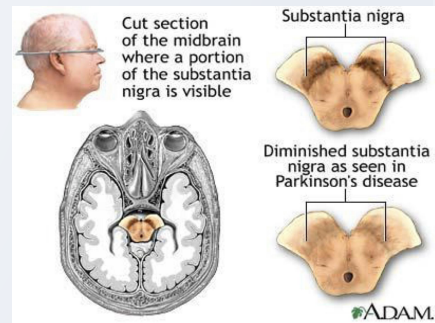
Cont.

Parkinson's disease

Degenerative disease

signs/symptoms: affects elders/expressionless face/hand shivering/tremors

Caused by: Loss(degeneration) of cells in the substantia nigra



Hemorrhagic skin rash

Drug induced disease

Example: girl with Sore throat, doctor gives her antibiotic, after taking the pills she suffers from (hemorrhagic skin rash)

Drug induced(toxins)

can cause diseases: in liver/kidneys/lungs/mostly rash



bacterial meningitis

Infective disease

Symptoms: headache/ high body temperature(39.5)/stiff neck/ fear of light (photophobia)

Caused by: a bacteria called streptococcus pneumoniae (pneumococcus)



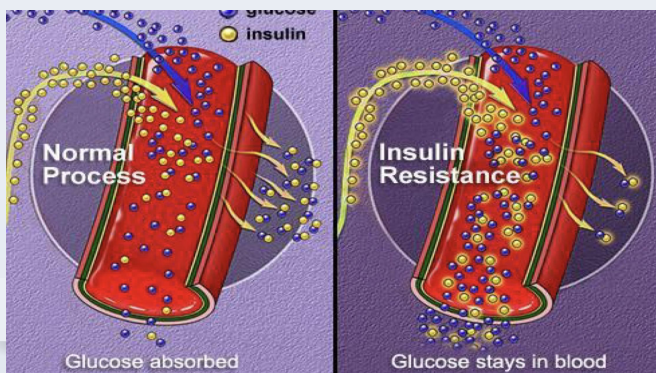
Diabetes

Metabolic disease

Most common one

Caused by: Error in the metabolism of carbohydrates

Harms: skin/kidney/liver/eye



Gout

Metabolic disease

mainly targets joints (especially the feet joints)

Caused by: An error in the metabolism of urate (uric acid) OR purine protein which form uric acid found in dna in nuclear material and it causes formation of urate crystals (uric acid crystals) which accumulate in joints and cause inflammation



T/F Qs:

- 1- **Idiopathic** means a known cause (...)
- 2- The beginning of signs and symptoms is the **outcome of the disease** (...)
- 3- **Incidence** is the total number of cases for a disease (...)
- 4- **Eczema/Dermatitis** is a metabolic disease (...)

1- F, Idiopathic is an unknown cause
2- F, Onset of a disease
3- F, prevalence
4- F, inflammatory disease

SAQs:

- 1- How do **Etiology & Pathogenesis** differ?
- 2- What's the cause of **Gout** disease, and the sites of it?
- 3- Define **Autopsy**, and reason to do it, and the benefits from it.

1- Etiology is the cause of disease, and pathogenesis is steps leading to the disease.
2- error in the metabolism of certain protein(purine) or urate(uric acid).
3- examining a dead body, determine cause of death, researches + students learning.

MCQs:

1- Signs:

- A- features of illness that the patient notice.
- B- are findings discovered by the physician during examination.
- C- complications and sequences
- D- stages of pathogenesis

2- Atherosclerosis/myocardial infarction:

- A- Inflammatory
- B- congenital inherited
- C- Vascular disease
- D- Drug induced

3- "In Saudi Arabia, There are 10 Tuberculosis patients per 100,000" . This is an example of:

- A- Morbidity rate
- B- Prognosis
- C- Sequelae
- D- Mortality rate

4- which of the following is correct about prevalence:

- A- it counts new cases only
- B- it gives you an idea of how many people already have the disease
- C- It helps us determine how lethal the disease is.
- D- It helps determine how likely a person is to get a disease

1- B, 2- C, 3- A, 4- B

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