INTRODUCTION TO PATHOLOGY

Girl's Slides Boy's Slides Doctor's Notes

Twitter: @Pathology438

Objectives

- Understands the **role of pathology** and its various subspecialities **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.

Definition of Pathology

- **Pathology** is defined as:

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.

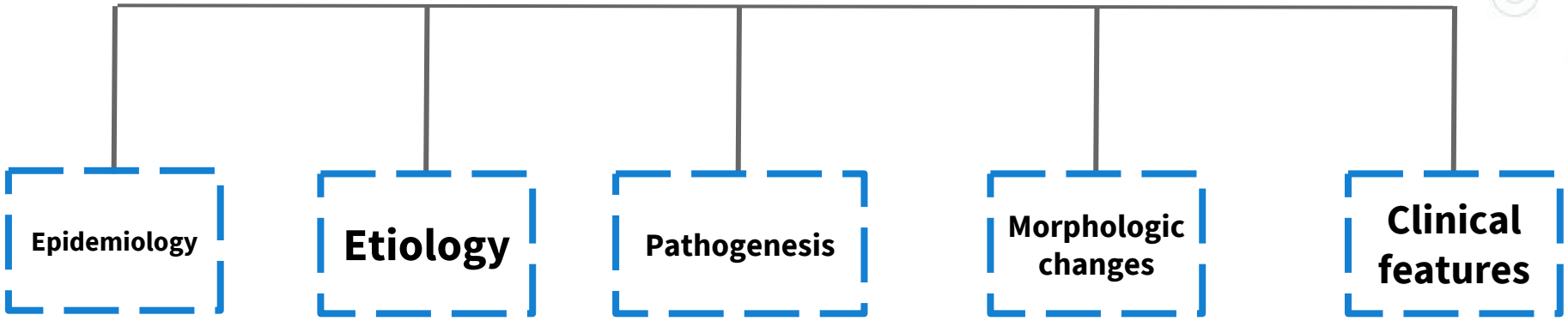
- **Disease** is defined as :
  an abnormality in structure or function of any part of the body.(a physiological or psychological dysfunction.)

Parts of Pathology

The following are the **5 major** aspects studied as part of pathology of any disease:

1. Epidemiology
2. Etiology
3. Pathogenesis
4. Morphologic changes
5. Clinical features (signs and symptoms)

PARTS OF PATHOLOGY



1. Epidemiology

- Study of the **occurrence and distribution 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.

- Epidemiology studies provide information regarding the following **factors**:
  a. **Sex**
  b. **Age**
  c. **Race**
  d. **Occupation:**

داء الإسبست أو داء الأميانت: التهاب طويل المدى وتليف رئوي للرئتين

1. workers in asbestos industry can have diseases like asbestosis or tumors like mesotheliomas. ورم الظهارة المتوسطة
2. workers in aniline dye industry can have urinary bladder cancer.
3. hardwood workers can have nasal cancer from inhalation of wood dust etc.

b. **Geographic location:** which part of the world a particular disease is common in, e.g:

1. underdeveloped countries has more malnutrition and infections like tuberculosis.
2. developed countries have more cardiac problems, obesity related diseases etc.

example on geographic location : a specific country suffers from water pollution , so a specific disease abounds there

1. Epidemiology (continued)

f)**Socioeconomic strata**: what is **the social and financial status** of the people affected by a particular disease.

g)**Prevalence**: is **the total number of cases** of a particular disease in a particular population in a particular period of time.

h)**Incidence**: is **the number of new cases** of a particular disease in a particular population in a particular period of time

(immunization programmes affect the incidence of a disease).

i)**Sequalea:** is **the complication or the consequence** of a disease.

i) sequalea: from the word sequence which in this concept means what happens to the patient after having the disease

j)**Prognosis**: is **the expected outcome** of the disease based on severity of any disease.

J) prognosis: means prediction, patient's prognosis could be one of the following:
- well prognosis: which means the patient is getting better.
- poor prognosis: which means the patient is getting worse which may lead to death.

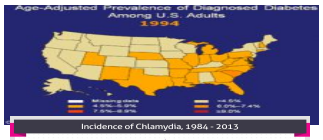
k)**Morbidity:** is **the presence of illness.**

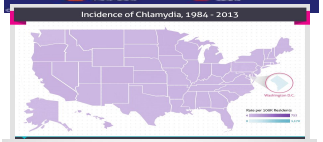
l)**Mortality rate:** is **a measure of the number of people dead** in a particular population during a particular period of time. Mortality rate can be calculated for any particular disease

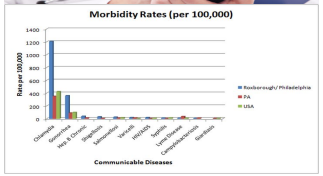
e.g. mortality rates are high for people with high grade cancers.

Epidemiologic Factors

- Sex
- Age
- Race
- Occupation
- Geographic location
- Socioeconomic strata
- Prevalence
- Incidence
- Sequalea
- Prognosis
- Morbidity (in population)
- Mortality rate







What is the Purposes or importance of Epidemiology?

The purpose of epidemiology: simply it states the story of a disease

1. To **investigate the extent of a disease** in a community.

2. To **study natural pattern/history and prognosis** of disease.

3. To **identify causes and risk factors.**

E.G.: Cause: chronic smoking
Risk : lung cancer

4. To **provide good health care** based on the findings.

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

E.G. on health programs (vaccinations for immunity)

6. To **evaluate all healthcare facilities** and programs.

7. **Provide information on public health** in order to help the health care system and develop health policies.

E.G. on providing information for public health (high children mortality rates means that there is some issues in the department of pediatrics)

2. Etiology & classification of disease

- **Etiology/General Pathology** means **the cause of the disease.**
- If **the cause of the disease is unknown** it is called **idiopathic/cryptogenic/ essential etc.**
- Diseases are **classified** depending on the **etiology and pathogenic** mechanism involved.
- Disease can be **congenital** or **acquired.**

CONGENITAL DISEASE	ACQUIRED DISEASE
Definition: Is a condition existing at birth or before birth, or that develops during the first month of life.	**Inflammatory:** e.g. rhematoid arthiritis,dermatitis(eczema).
Genetic/ chromosomal: e.g. **hemophilia** (an x-chromosome linked disorder,reduction or absence of blood clotting factor), **Down syndrome** (chromosomal abnormality with extra chromosome 21), inborn error of metabolism, defective epithelial ion transport mechanism causes thick, sticky mucous secretions which lead to **cystic fibrosis**(autosomal recessive). It's rare for females to have hemophilia ,they just carry it.	**Infective:** bacterial, viral, fungal.
	Vascular: e.g. atherosclerosis (heart attack) or Immune mediated e.g. vasculitis etc.
	degenerative alzheimer's: the brain start to degenerate. Parkinsonism: الشلل الارتعاشي **Degenerative:** e.g. Alzheimer's and Parkinsonism.
	Neoplastic/growth disorder:e.g. cancer.
	Therapeutic or recreational drug associated disease: e.g. certain drugs can cause **liver or kidney failure**, **bone marrow suppression**, **skin rash**. Alcohol can causes liver disease, paraquat poisoning damages the lungs and excessive smoking causes lung and cardiac problems.
Non-genetic: an abnormal defect or deformity a child is born with e.g. a birth defect like **cleft lip** or **spina bifida** etc. Cleft lip : الشفة الأرنبية أو الشفة المشقوقة Spina bifida: انشقاق العمود الفقري أو السنسنة المشقوقة	**Metabolic:** Gout :داء المفاصل e.g. gout, diabetes mellitus, kidney stones
	Nutritional: deficiency diseases e.g. anemia, protein energy malnutrition etc.
	Radiation: radiation to neck can cause thyroid cancer or radiation to skin can causes skin cancer (squamous cell carcinoma) etc
	Mechanical: e.g. road traffic accident, burns etc

3. Pathogenesis

-pathogenesis (study of creation or beginning)

Pathogenesis/Systematics Pathology:it is **the steps that take place in the body once the problem begins** (whatever it may be) that finally lead to tissue injury (pathological manifestations).

The four basic pathogenetic mechanisms (or steps that usually take place in diseases) are as follows:

1. **Inflammatory process.***
2. **Degenerative process.***
3. **Carcinogenesis:*** transformation of normal cells to malignant.
4. **Immunological process.***

Pathogenesis leads to morphologic changes (changes in the gross or microscopic appearance of human tissue).

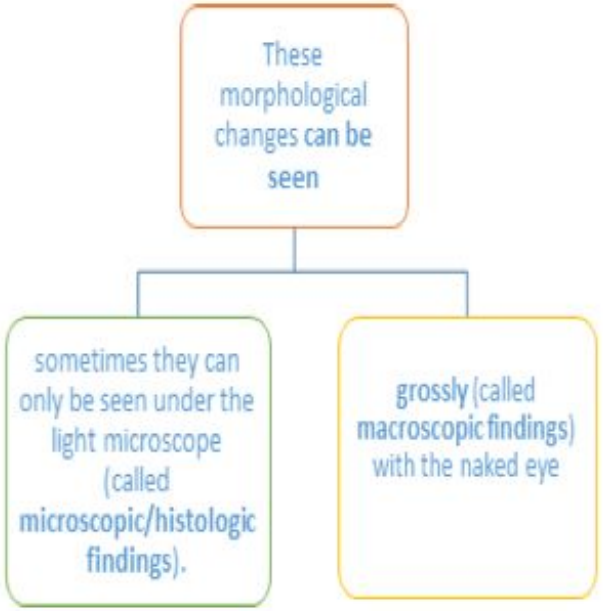
***All these will be dealt with in later chapters**

4. MORPHOLOGIC CHANGES

-morphologic (architecture or structure of any part of the body)

The morphologic changes are the structural changes that take place in cells or tissues due to any disease.

Macroscopic findings	• Can be seen **grossly** • With the naked eye
Microscopic(histologic findings)	• Can only be seen under **the light microscope**



• Commonly diseases have certain specific gross or microscopic changes and **this helps in the diagnosis of that disease.**

5 .CLINICAL FEATURES (FUNCTIONAL ALTERATIONS)

• When an organ is damaged by a disease, the normal function of that organ is affected and this will lead to the development certain clinical changes called **signs & symptoms**.

• **Symptoms**: is 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.

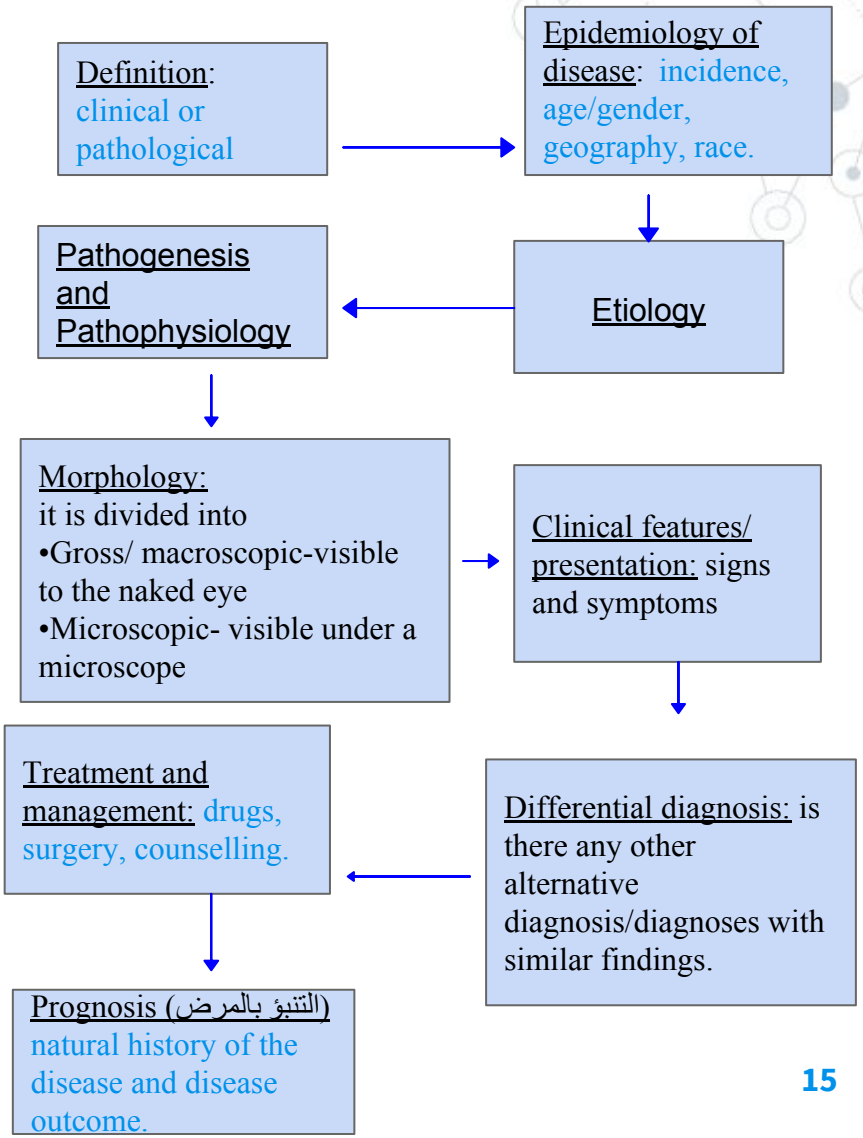
• **Signs**: are findings discovered by the physician during examination of the patient e.g. doctor finds a swelling somewhere or doctor find a liver or spleen enlargement while examining the abdomen etc. Basically it is what the doctor will find on examining the patient.

• The combination of **signs** and **symptoms** is called as clinical features.

PATHOLOGY

- Epidemiology
- Etiology (the cause leads to the beginning of pathogenesis)
- Pathogenesis
- Morphological or chemical alteration
- Clinical features (signs and symptoms)

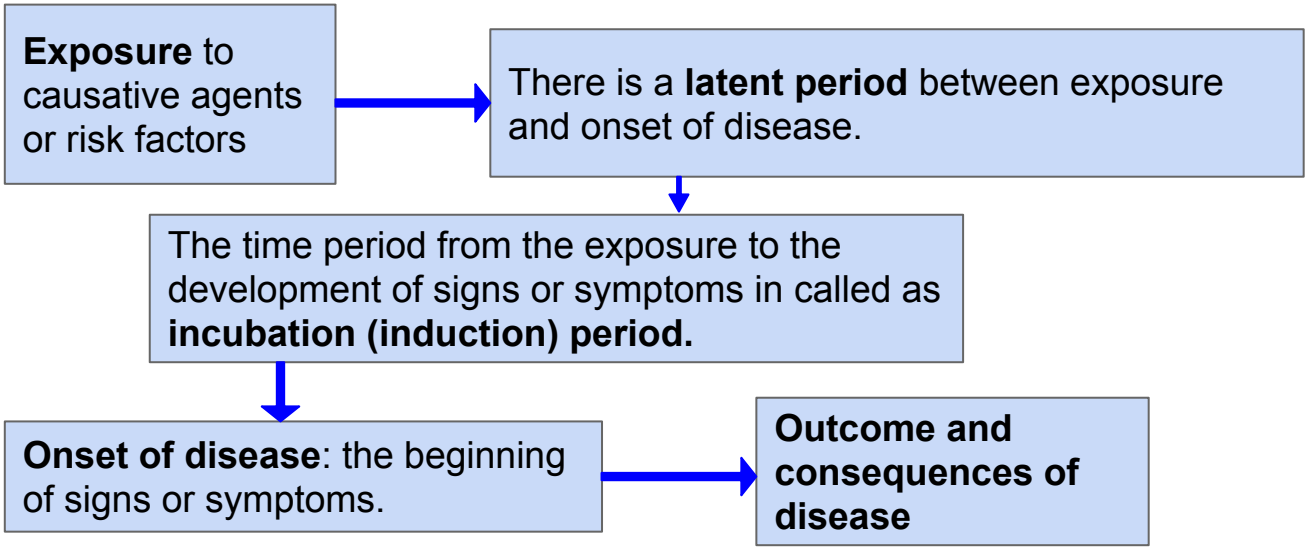
THEREFORE IN MEDICINE, DISEASES ARE STUDIED UNDER THE FOLLOWING HEADINGS:



COURSE OF DISEASE

• 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:



• **Outcome and consequences of disease**: Following clinical onset, disease may follow any of the following trends:

-**Recovery**/resolution of disease without complication or sequalae. Person is back to normal health.
-**The disease recovery but with sequelae**
-**Complications**: Development of complications in any disease can make things worse.
-**Death**

complications - E.G.: diabetes leads to infections like (غرغرينا;gangrene)

A timeline shows the states of disease progression

THE DIAGNOSTIC PROCESS AND THE ROLE OF PATHOLOGIST

Any patient going to a clinic meets clinician who will :

1-Take history and do clinical examination.
2-Ask for radiological and pathological examination.

The common pathological examinations are:

- Blood.
- Urine.
- Stool.

Sometimes the patient is also asked to undergo:

- Cytopathology test.
- Histopathology test.
- 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**.

Note: BOYS SLIDES ONLY

- Clinical pathology: it is more concerned with laboratory investigations of an illness and a cross-sectional analysis at the level of the disease itself to determine the cause and the effects of the disease itself upon organ systems of the body.

- Experimental pathology: it is the observation of the effects of manipulations on experimental systems, such as animal models of disease or cell cultures.

THE BRANCHES/SUBDIVISIONS OF PATHOLOGY:

Histopathology	study of tissue biopsied/excised from body
Cytopathology	study of cell morphology, exfoliated or aspirated from body.(examination of isolated cells)
Hematology	a study of blood, blood cells and bone marrow, used in the diagnosis of anemias & leukemias.(blood is easy to sample by venepuncture.)
Immunohistochemistry	a special staining procedure is used to detect antigens in the tissue.
Chemical pathology/ clinical biochemistry	is the analysis of bodily fluids (blood, urine, etc.) for diagnosis.(chemical changes in tissue and fluids.)
Microbiology	is the study of microorganisms.(effusions of fluid into body cavities,e.g:pleural. Effusions and exudates may be provoked by infections.)
immunology	is the analysis of the immune system of the body.(defense mechanisms of the body.)
Toxicology	study of various poisonous and toxic substances.
Cytogenetics (clinical genetics)	is a study of chromosomal abnormalities.
Molecular pathology	study of the genetic material to detect their diseases e.g. fluorescent in situ hybridization, Southern blot tests etc.
Autopsy/Forensic Pathology	discussed in the last slide.

HISTOPATHOLOGY

Histopathology: It is the study of tissues using light microscope. Tissues are obtained by **biopsies (a sample of a tissue)** by physicians and surgeons.

Biopsies can be obtained by a variety of methods:

- **Endoscopic biopsy**: visually-guided biopsy of an internal body surface.
(e.g.alimentary or respiratory tracts).
- **incisional biopsy**: tissue removed by surgical incision.

Once the tissue is removed from the patient's body it is:

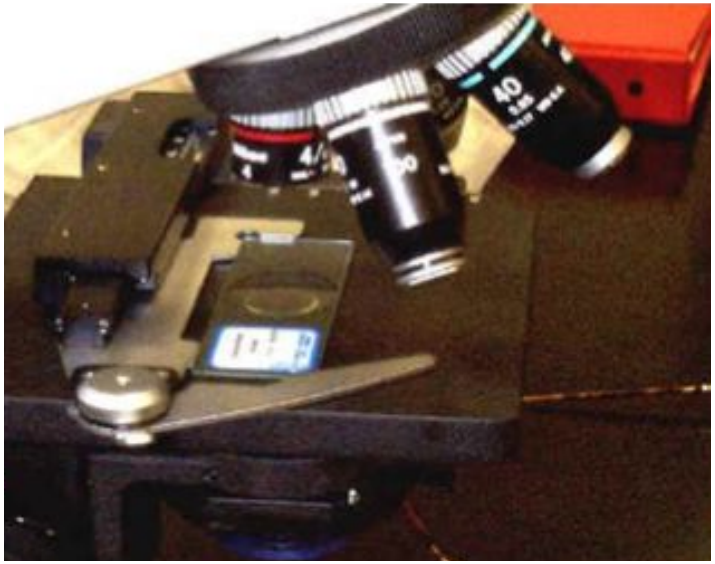
1- immediately preserved(fixed) by putting it in a container of **formalin**(10% formaldehyde). The purpose of **fixation** is to prevent **autolysis** and **decomposition** of the tissue.

2- Tissue is processed in a special multisteps way and the end result is very **thin** slices of **stained** tissue (4-6 microns) glued on a slide.

HISTOPATHOLOGY CONT…

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

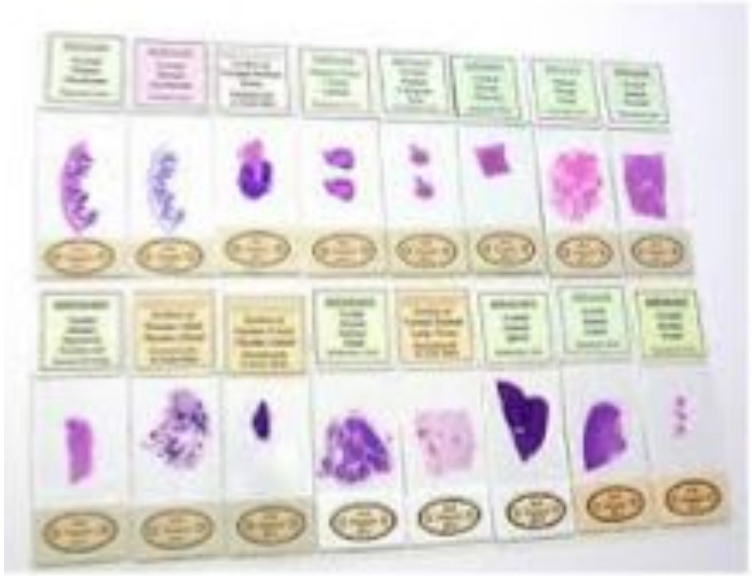
• The pathologist will look at the slide under the microscope and give a diagnosis.



• Histopathology is usually the **final/golden 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**.

HISTOPATHOLOGY SLIDES READY TO BE EXAMINED UNDER A LIGHT MICROSCOPE



CYTOPATHOLOGY

Cytopathology: is the study of morphology of isolated cells which are obtained by scraping (exfoliative cytology), aspiration (fine-needle aspiration cytology), washing or fluid 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. Cells sucked out of a solid tissue (e.g.breast lump) using a thin needle attached to a syringe.

Fluid cytology: cells withdrawn with the fluid in which they are suspended **(e.g. Urine).**

Washing: cells flushed out of an organ using an irrigating fluid.

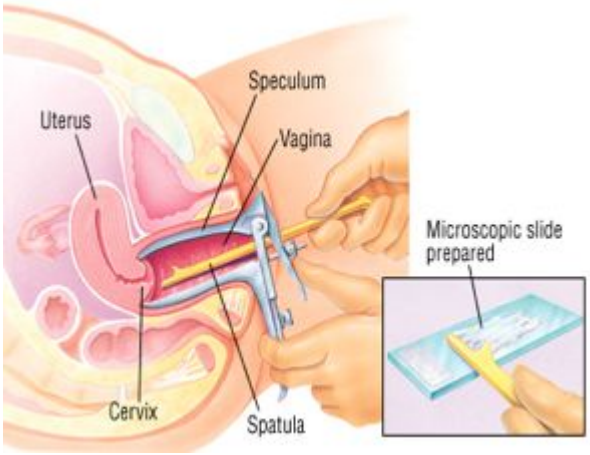
• **Exfoliative (falling or scraping off) cytology:** Cells shed from an epithelial surface or scraped of any mucosa using a spatula **(e.g. cervix and oral cavity)** or the cells exfoliate (fall off) themselves and collect in the respective fluids/secretion **(e.g. in urinary tract disease the cells which exfoliate collect in the urine, sputum etc).**

• **The morphology** of the cells are studied and a diagnosis made from it. **It is used for the purpose of:**

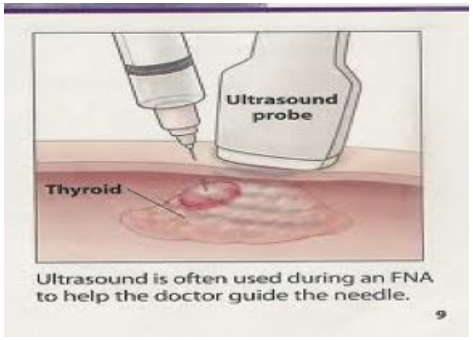
1. Screening for cancer **e.g. cervical cytology is used in the screening of carcinoma of cervix.**
2. Diagnosing cancer.

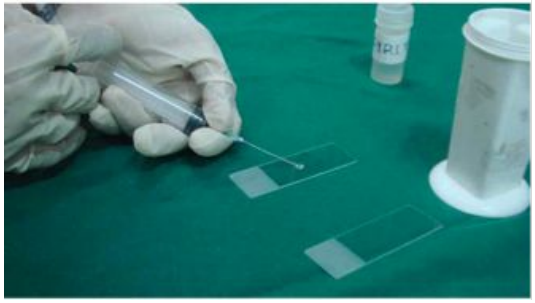
• The advantage of cytologic techniques when compared to histopathological techniques is that the procedure is **cheap**, **takes less time** and **requires no anesthesia.**

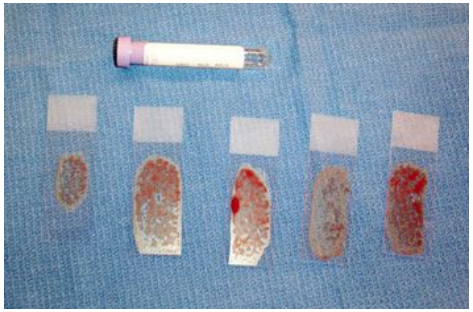
Exfoliative Cytology :

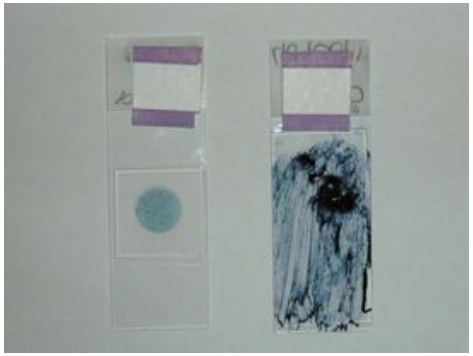


Fine needle aspiration cytology (suction of cells)

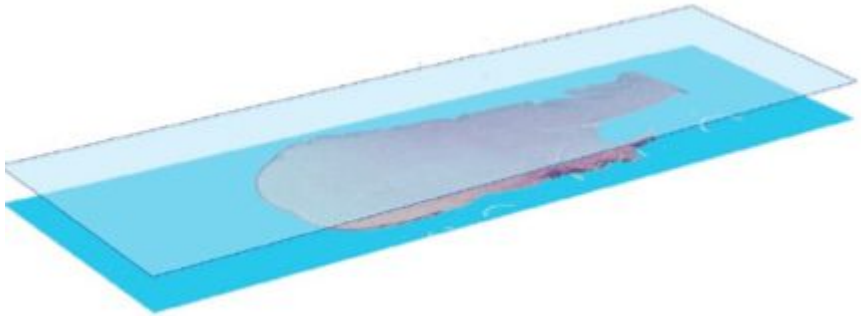


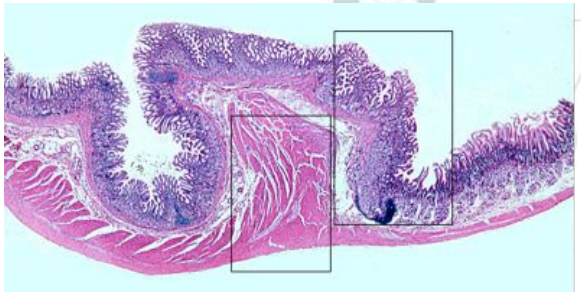




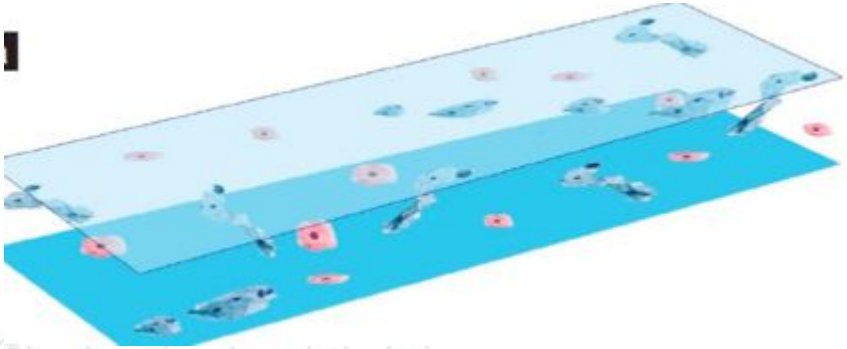


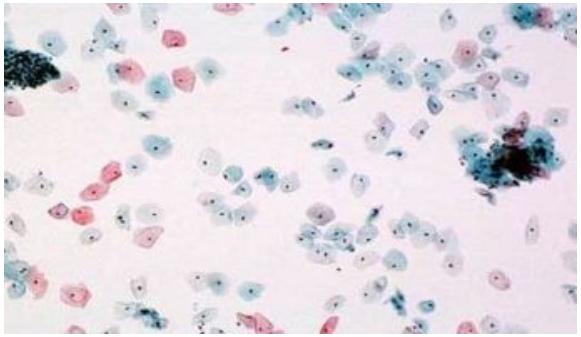
A) Histology





B) Cytology





AUTOPSY

Autopsy/Forensic pathology: Is a subspecialty of pathology to legal purpose which involves examining a dead body. (e.g. investigation of death in suspicious circumstances).

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:
  1. Homicidal
  2. Suicidal
  3. Accidental
  4. To identify the disease
- To provide useful information about various disease.
- To do research.
- To audit (assess or check) the accuracy of clinical diagnosis
- Also it can be used as a tool to educate students, surgeons etc…

The person who does the Autopsy is pathologist.

SOME INSTRUMENTS IN PATHOLOGY

There are different diagnostic instruments used in pathology.

Some of the instruments used in pathology are:

- **Light microscope.** The sample that will be examined must be thinly sectioned to permit the transmission of light, And the sections are stained with **haematoxylin** and **eosin** stains to **help distinguish** between the different components of the tissue (e.g. nuclei, cytoplasm, collagen).

- **Immunofluorescent microscope:** Uses a special blue filter and a fluorescent dye on 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.

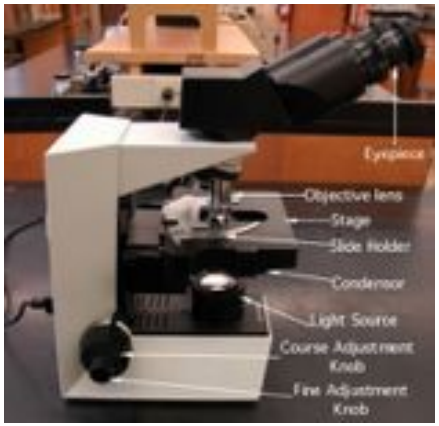
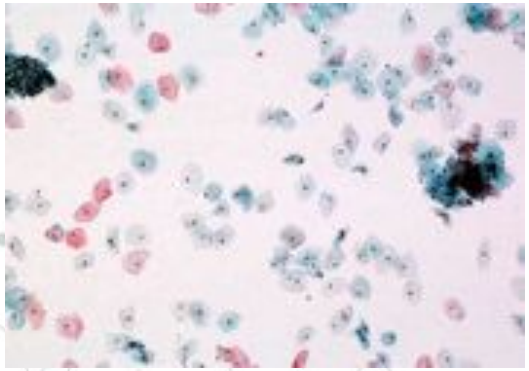
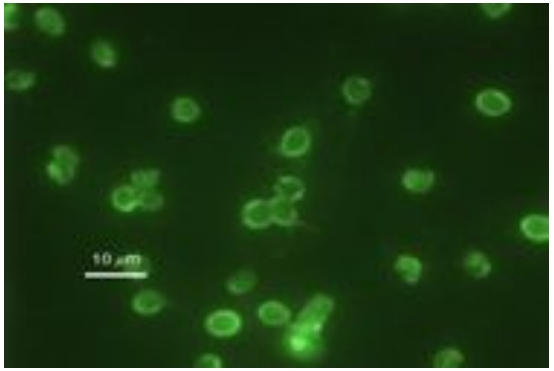
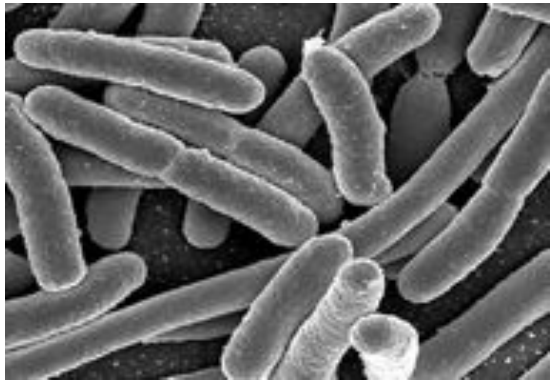
- **Electron microscope:** Has extended the range of pathology to the study of disorders at the organelles level. magnifies up to **two million times**, which is much higher than a light microscope.It enables us to see cell structure like **mitochondria, endoplasmic reticulum, viral particles etc**. It is also called as ultra structural studies. It is an expensive technique.

- **Immunohistochemistry:** The end product is a deposit of opaque or coloured material that can be seen with a conventional light microscope and does not deteriorate.

- **Haematological Techniques:** Used in the diagnosis and study of blood disorders.

- **Cell cultures:** can be modified and the responses to it monitored (observed). Used to prepare chromosome spreads for cytogenetic analysis

INSTRUMENT USED IN PATHOLOGY

Light microscopy :	Immunofluorescence microscopy :	Electron microscope :
		
		

SUMMARY

- **Pathology**: the study of changes in cells and tissue as a result of any injury in the cell or tissue.
- **Parts of Pathology:**

1- Epidemiology (study of occurrence and distribution of diseases in a population)

2- Etiology (cause of the disease)

Classification of disease:

A- *Congenital* B- *Acquired*

-Disease of unknown cause: idiopathic/cryptogenic/essential

3- Pathogenesis (steps that take place in body once the problem begins, which leads to tissue injury)

Basic mechanisms: 1) Inflammatory process

2) Degenerative process

3) Carcinogenesis (change of *normal* cells to *malignant*)

4) Immunological process

4- Morphologic Changes (structural changes in cells/tissues due to disease)

- *Macroscopic findings:* seen grossly
- *Microscopic findings:* seen under light microscope

5- Clinical Features (signs & symptoms)

Doctors sees while examining *Patient tells doctor*

SUMMARY CONT.

- **Course of Disease:** different stages in the natural history of a disease w/o any intervention.
  1) Exposure
  2) Incubation (induction) period
  3) Onset of disease
  4) Outcome and consequences of disease

- **Branches of Pathology:**

1) Histopathology: study of tissue biopsied from body.

1- Endoscopic biopsy: visually-guided biopsy of an internal body surface.

2-Incisional biopsy: tissue removed by surgical incision.

*most common routine stain: Hematoxylin & Eosin

2) Cytopathology: Study of morphology of isolated cells.

Cells obtained by:

1) Exfoliative (falling or scraping) cytology
2) Fine-needle aspiration cytology (FNAC)
3) Fluid cytology
4) Washing

3) Hematology **4) Immunochemistry** **5) Chemical pathology/ clinical biochemistry**
6) Microbiology **7) Immunology** **8) Toxicology**
9) Cytogenetics (clinical genetics) **10) Molecular Pathology**
11) Autopsy: examination of a dead body.

Reason why it's done: determine cause of death

SUMMARY CONT.

Instruments in Pathology

1) Light microscope
2) Immunofluorescent microscope
3) Electron microscope
4) Immunohistochemistry
5) Haematological techniques
6) Cell cultures

- **Prevalence**: is the total number of cases.
- **Incidence:** is the number of new cases.
- **Sequalea:** complication or the consequence of a disease.
- **Morbidity:** is the presence of illness.
- **Mortality Rate:** a measure of the number of people dead.

Quiz:

MSQ'S:

1-A patient has come to the ER with 2nd degree burns. She is treated and it heals but she develops a scar. What is the correct term used to describe this:

A- prognosis
B-infective
C-Neoplastic
D-sequalea

2-Prognosis of a patient is always:

A-poor
B-good
C-depends on the severity of the disease

3-When Pathologists rapidly process a tissue to give diagnosis, this is called:

A-frozen section
B-exfoliation
C-biopsy
D-fine needle aspiration cytology

Fill in the blanks:

1-..... Is the number of new cases of a particular disease in a particular population in a particular period of time.

2-..... Are findings discovered by the physician during examination of the patient.

True or false:

The following statements is/are correctly paired:
1-Idiopathic=without known reason

2-pathogenesis=direct cause of disease

3-sequelae= complication of a disease

4-signs=features of an illness that the patient notices

5-prognosis= 5 and 10 years survival rates following the diagnosis of a disease

MCQ's: 1-D 2-C 3-A
Fill in the blanks: 1-Incidence 2-sign
T or F: 1-T 2-F 3-T 4-F 5-T

Team Leaders

نجود العبداللطيف ومهند أحمد

Team Members

- إبراهيم الدخيل
- إبراهيم الشقراوي
- أمجد البارودي
- أميرة الزهراني
- الهنوف الهلولي
- الوليد صالح
- بدر القرني
- حميد الحافظ
- دينا عورتاني
- رهام يوسف
- ريما السرحاني
- ريما المطوع
- ريما القحطاني
- ريناد المطوع
- سارة العريفي
- سهيل باسهيل
- شهد بن سليم
- طيبة الزيد
- طيف الشمري
- طارق العقيل
- عبدالرحمن الحواس
- عبدالله الحوامدة
- عبدالله العيسى
- عبدالله النويبت
- غادة السدحان
- غيداء الشهري
- فيصل القبلان
- لمى الزامل
- لينا النصار
- محمد عجارم
- مهند مكاوي
- نايف السليس
- نجود العلي
- نورة المزروع
- هتون النعمي
- هيفاء العيسى
- ياسمين الموسى