**NAME: RASAQ NASIRAT OMOLARA**

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**COURSE TITLE: CELLULAR PATHOLOGY**

**COURSE CODE: NSC 308**

**QUESTION 1:** Write with explicitly on 5 diagnostic techniques use in pathology, relevant illustrations and examples required.

 **ANSWER**

1. **Histopathological techniques:** Histopathological examination studies tissues under the microscope for abnormal structures in the tissue. This is done by the pathologist. Tissues for histopathological examination is are obtained by biopsy. Biopsy is a tissue sample from a living person to identify disease. Biopsy can either incisional or excisional. Immediately the tissue is collected from the patient, it has to be fixed by putting it into adequate amount of 10% formaldehyde before sending it to the pathologist.

**The purpose of fixation is:**

1. To prevent autolysis and bacterial decomposition and putrefaction.
2. To coagulate the tissue to prevent loss of easily diffusible substances.
3. To fortify the tissue against the deleterious effects of various stages in the preparation of sections and tissue processing.
4. To leave tissue in a condition which facilitate differential staining with dyes.

As soon as the tissue arrives to the pathology department, the pathologist will examine it microscopically. Then the tissue is processed to make it available for microscopic examination. The whole purpose of the tissue processing is to prepare a very thin tissue which can be clearly seen under the microscope. The tissue is processed by putting it into different chemicals. It is then embedded in paraffin, sectioned into thin slices and finally stained. The stains can be Hematoxylin/Eosin stain or special stains such as PAS, immunohistochemistry, e.t.c.

 The Hematoxylin/Eosin (H&E) stain is usually routinely used. It gives the nucleus a blue color and the cytoplasm & the extracellular matrix a pinkish color. Then the pathologist will look for abnormal structure in the tissue. Based on the abnormal structure he or she can make diagnosis**.**

1. **Cytopathologic techniques:** This involves the study of cells from various body sites to determine the cause or nature of disease. It is often aid in the diagnosis of cancer but also in the diagnosis of other infectious diseases and other inflammatory conditions.

**Applications of cytopathology:**

1. Screening for the early detection of asymptomatic cancer: For example, the examination of scrapings from cervix (pap smear) for early detection and prevention of cervical cancer.
2. Diagnosis of symptomatic cancer: Cytopathology alone or in conjunction with other modalities to diagnose tumors revealed by physical or radiological examinations. It can be used in the diagnosis of cysts, inflammatory conditions, and infection of various organs.
3. Surveillance of patients treated for cancer: For some types of cancers, cytology is the most feasible method of surveillance to detect recurrence. The best example is periodic urine cytology to monitor the recurrence of cancer of the urinary tract.

**Cytopathologic methods:**

1. Fine- needle aspiration cytology (FNAC): In FNAC, cells can be obtained by aspirating the diseased organ using a very thin needle under negative pressure. The aspirated cells are then stained and studied under the microscope. Superficial organs e.g thyroid, breast, lymph nodes, skin and soft tissues can be easily aspirated. Deep organs, such as the lung, mediastinum, liver, pancreas, kidney, adrenal gland and retroperitoneum are aspirated with guidance by fluoroscopy, ultrasound or CT scan.
2. Exfoliative cytology: this refers to examination of cells that are shed spontaneously into body fluids or secretions. Examples include sputum, cerebrospinal fluid, urine, effusions in the body cavities (pleura, pericardium, peritoneum), nipple discharge and vaginal discharge.
3. Abrasive cytology: This refers to methods by which cells are dislodged by various tools from body surfaces (skin, mucous membranes). E.g preparation of cervical smear with a spatula or a small brush to detect cancer of the uterine cervix at early stages. This can significantly reduce the mortality from cervical cancer.

**Advantages of cytologic examination**

Compared to histopathologic technique it is cheap, takes less time and needs no anesthesia to take specimens.

1. **Microbiological examination:** This is a method by which body fluids, excised tissue, e.t.c are examined by microscopic, cultural and serological techniques to identify micro organisms responsible for many diseases. The microbiology laboratory is composed of several sections including
2. The aerobic bacteriology section
3. The mycology section
4. The parasitology section
5. The virology/Sexually Transmitted Diseases (STD) section
6. The mycobacteriology section
7. **Biochemical examination:** This is a method by which the metabolic disturbances of disease are investigated by assay of various normal and abnormal compounds in the blood, urine and cerebrospinal fluid. By discovering how and where the body’s chemistry has changed, diseases can be diagnosed and monitored. Biochemical pathology brings together science and medicine by understanding the chemistry of fluids and monitoring these, pathologist can tell whether a patient’s organs are working properly, diagnose diseases and recommend treatment. For example high glucose levels in blood may be the sign of diabetes.

For example, glucose is a sugar that provides fuel for the body. The blood glucose level is regulated by the hormone, insulin. If the body doesn’t produce enough insulin, diabetes may develop. Measurement of blood glucose and lipids are among the commonly performed tests in the biochemistry examination.

1. **Autopsy:** Autopsy is an examination of the dead body to identify the cause of the death. This can be for forensic or clinical purposes.

**Purposes:** Autopsies can be performed when any of the following information is desired:

1. Determine if death was natural or unnatural
2. Injury source and extent on the corpse
3. Manner of death must be determined
4. Time since death
5. Establish identify of the deceased
6. Retain relevant organs
7. If it is an infant, determine live birth and viability

 For example, a forensic autopsy is carried out when the cause of death may be a criminal matter, while a clinical autopsy is performed to find the medical cause of death and used in cases of unknown or uncertain death.

There are four main type of autopsy:

1. Medico-legal or forensic or coroner’s autopsies: Seek to find the cause and manner of death and to identify the decedent. They are generally performed, as prescribed by applicable law in cases of violent, suspicious or sudden deaths, deaths without assistance or during surgical procedures.
2. Clinical or pathological autopsies: Are performed to diagnose a particular disease or for research purposes. They aim to determine, clarify or confirm medical diagnoses that remained unknown or unclear prior to the patient’s death’
3. Anatomical or academic autopsies: Are performed by students of anatomy for study purpose only.
4. Virtual or academic autopsies: Are performed utilizing imaging technology only, primarily magnetic resonance imaging (MRI) and computed tomography (CT).

**QUESTION 2:** Cellular adaptation precedes cell death, discuss. Diagrams essential.

 **ANSWER**

1. **Atrophy:** Atrophy is the partial or complete wasting away of a part of the body. Causes of atrophy include mutation, poor nourishment, poor circulation, loss of hormonal support, loss of nerve supply to the target organ excessive amount of apoptosis of cells and disuse or lack of exercise. This is a decrease in the cell size. If enough cells in an organ undergo atrophy the entire will decrease in size. Thymus atrophy during early human development (childhood) is an example of physiology atrophy. Skeletal muscle atrophy is a common pathologic adaptation to skeletal muscle disuse (commonly called “disuse atrophy”). Tissue and organs especially susceptible to atrophy include skeletal muscle, cardiac muscle, secondary sex organs and the brain.



1. **Hypertrophy:** This is an increase in cell size and volume. If enough cells of an organ hypertrophy the whole organ will increase in size. Hypertrophy may involve an increase in intracellular protein as well as cytosol and other cytoplasmic components. For examples, adipocytes(fat cells) may expand in size by depositing more lipid within the cytoplasmic vesicles. Thus in human adults, increases in the body fat tissue occurs mostly by increases in the of adipocytes not by in the number of adipocytes. An example of physiologic hypertrophy is in skeletal muscle with sustained weight bearing exercise. An example of pathologic hypertrophy is in cardiac muscle as a result of hypertension.

 

1. **Hyperplasia:** Hyperplasia is an increase in the number of cells. It is the result of increased cell mitosis or division also referred to as cell proliferation. The two types of physiologic hyperplasia are compensatory and hormonal. Compensatory hyperplasia permit tissue and organ regeneration. It is common in epithelial cells of the epidermis and intestine, liver hepatocytes, bone marrow cells and fibroblasts. It occurs to a lesser extentnin bone, cartilage and smooth muscle cells. Hormonal hyperplasia occurs mainly in organs that depend on estrogen. For example, the estrogen-dependent uterine cells undergo hyperplasia and hypertrophy following pregnancy. Pathologic hyperplasia is an abnormal increase in cell division. A common pathologic hyperplasia in woman occurs in the endometrium and is called endometriosis.

 

1. **Metaplasia:** Cell observed under the microscope appear normal, but not the cell type usually found in that bodily tissue or area. It occurs when a cell of a certain types 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 mataplasia involves the changes associated with the respiratory tract in response to inhalation of irritants such as smoke or smog. The most common example of metaplasia is Barrett’s esophagus, when the non-keratinizing squamous epithelium of the esophagus undergoes metaplasia to become mucinous columnar cells. If stress persists, metaplasia can progress to dysplasia and eventually carcinoma; Barrett’s esophagus, for example, can eventually progress to adenocarcinoma.



1. **Dysplasia:** Cells have an abnormal appearance under the microscope and are disorganized. It is refers to abnormal changes in cellular shape, size, and/or organization. Tissues prone to dysplasia include cervical and respiratory epithelium, where it is strongly associated with the development of cancer. Although dysplasia is reversible, if stress persists, then dysplasia progresses to irreversible carcinoma. People with dysplasia are usually checked on a regular basis so that treatment can be initiated if cell changes become severe.

