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**17/MHS02/ 026**

**Nursing science**

Cellular pathology

**Question**
1. Write explicitly on 5 diagnostic techniques use in pathology, relevant illustrations and examples required. 2. Cellular Adaptation precedes cell death, discuss. Diagrams essential.

The pathologist uses the following techniques to the diagnose diseases:

a. Histopathology

b. Cytopathology

c. Hematological techniques

d. Immunohistochemistry

e. Autopsy

A. **Histopathological techniques**

 Histopathological examination studies tissues under the microscope. During this study, the pathologist looks for abnormal structures in the tissue.

 Tissues for histopathological examination are obtained by biopsy.  Biopsy is a tissue sample from a living person to identify the disease.  Biopsy can be either incisional or excisional.

 Once the tissue is removed from the patient, it has to be immediately fixed by putting it into adequate amount of 10% Formaldehyde (10% formalin) 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 the various stages in the preparation of sections and tissue processing.

4.  To leave the tissues in a condition which facilitate differential staining with dyes and other reagents.

 Once the tissue arrives at the pathology department, the pathologists will exam it macroscopically (i.e. naked-eye examination of tissues).

Then the tissue is processed to make it ready for microscopic examination. The whole purpose of the tissue processing is to prepare a very thin tissue (i.e. five to seven μm or one cell thick tissue) which can be clearly seen under the microscope. The tissue is processed by putting it into different chemicals. It is then impregnated (embedded) in paraffin, sectioned (cut) into thin slices, & is finally stained. The stains can be Haematoxylin/Eosin stain or special stains such as PAS, Immunohistochemistry, etc...

The Haematoxylin/Eosin stain is usually abbreviated as H&E stain. The H&E stain is routinely used. It gives the nucleus a blue colour & the cytoplasm & the extracellular matrix a pinkish colour. Then the pathologist will look for abnormal structures in the tissue. And based on this abnormal morphology he/she will make the diagnosis. Histopathology is usually the gold standard for pathologic diagnosis.

**B. Cytopathologic techniques**

 Cytopathology is the study of cells from various body sites to determine the cause or nature of disease.

Applications of cytopathology:

 The main applications of cytology include the following:

1.  Screening for the early detection of asymptomatic cancer

For example the examination of scrapings from cervix is used for early detection and prevention of cervical cancer.

 2. Diagnosis of symptomatic cancer

Cytopathology may be used 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 infections 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.

Advantages of cytologic examination

Compared to histopathological technique it is cheap, takes less time and needs no anaesthesia to take specimens. Therefore, it is appropriate for developing countries with limited resources like Ethiopia. In addition, it is complementary to histopathological examination.

Cytopathologic methods

  There are different cytopathology methods including:

 1. Fine-needle aspiration cytology (FNAC)

In FNAC, cells are obtained by aspirating the diseased organ using a very thin needle under negative pressure. Virtually any organ or tissue can be sampled by fine-needle aspiration. The aspirated cells are then stained & are 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 retro peritoneum are aspirated with guidance by fluoroscopy, ultrasound or CT scan. FNAC is cheap, fast, & accurate in diagnosing many diseases.

2. Exfoliative cytology

This refers to the examination of cells that are shed spontaneously into body fluids or secretions. Examples include sputum, cerebrospinal fluid, urine, effusions in body cavities (pleura, pericardium, peritoneum), nipple discharge and vaginal discharge.

3. Abrasive cytology

 Refers to methods by which cells are dislodged by various tools from body surfaces (skin, mucous membranes, and serous membranes). E.g. is the preparation of cervical smears with a spatula or a small brush to detect cancer of the uterine cervix at early stages. Such cervical smears, also called Pap smears, can significantly reduce the mortality from cervical cancer. Cervical cancer is the most common cancer in Ethiopian women.

 C. ) Hematological techniques: this is a method by which abnormalities of the cells of the blood and their precursors in the bone marrow are investigated to diagnose the different kinds of anemia and leukemia. The examination is the first step to a hematological diagnosis and treatment of blood disorders such as anemia, abnormalities of the red blood cells, disease related to defective blood clotting, thromboembolic diseases Such as thrombus formation, and immunoheamatological diseases. Furthermore it is used to diagnose and identify the best treatment for blood cancer, Hodgkin’s disease, acute and chronic leukemia, myeloma and myeoproliferative disorders such as essential thrombocytothemia, polycythemia vera, and myelofibrosis. Others include hematological disease of the elderly such as myelodysplasia and low malignant lymph proliferative disorders, arterial thromboembolic disease, thrombophilia, thrombosis and clotting abnormalities. During the visit, a hematologist collects information about the history and lifestyle of the patient such as nutrition, smoking habits, physical inactivity, pathologies, previous interventions, a family history of similar diseases, and a medication intake. A hematologist then conducts a thorough clinical examination that can last between 20 and 40 minutes, during which the doctor feels the abdominal area, listens to the heart and lungs, and looks for enlarged lymph nodes. A hematologist will view prior exams or prescribe them when necessary, to determine an appropriate course of action.

D. Immunohistochemistry: this is a method used to detect a specific antigen in the tissue in order to identify the type of disease. IHC offers several distinct advantages when compared to traditional methods. This technique is rapidly expanding the diagnostic capability of pathologist. IHC permits rapid identification. The technique employs specific antibodies, which localize to the antigens of the etiological agent of interest. Since this technique uses formalin-fixed tissues, specimen transport is simplified, allowing retrospective studies and minimizing laboratory worker exposure to infectious agents. IHC is a sensitive and specific test methodology for many microorganisms, and unlike some traditional staining methods, they result in direct, highly interpretable visual evidence of the presence of an infectious agent within tissues. In addition, IHC detects organisms that are difficult to culture and those that cannot be cultured. IHC provides invaluable information for clinical diagnosis as well as for the study of pathogenesis. IDPB has developed many specific IHC assays for emerging or re-emerging infectious diseases. Currently, IDPB has diagnostic IHC assays for more than 100 etiologic agents, including viral, bacteria, parasitic and fungal organisms. For a number of agents, IHC tests may provide the only reliable methods of detection.

E. Autopsy: Autopsy is examination of the dead body to identify the cause of death. This can be for forensic or clinical purposes. The relative importance of each of the above disciplines to our understanding of disease varies for different types of diseases. For example, in diabetes mellitus, biochemical investigation provides the best means of diagnosis and is of greatest value in the control of the disease whereas in the diagnosis of tumours, FNAC & histopathology contribute much. However, for most diseases, diagnosis is based on a combination of pathological investigations.

2. Cellular adaptation is the ability of cells respond to various types of stimuli and adverse environmental changes. These adaptations include

* Hypertrophy (enlargement of individual cells)
* Hyperplasia (increase in the number of cells)
* Atrophy (reduction in the number and size of cells) this is caused majorly by Disuse, under nutrition, Decreased endocrine stimulation, Denervation, Old age.
* Metaplasia (transformation of one epithelium to another)
* Dysplasia (disordered growth of cells).

Tissues adapt differently depending on the replicative characteristics of the cells that make up the tissue. For example, labile tissue such as the skin can rapidly replicate and therefore can also regenerate after injury whereas permanent tissue such as neural and cardiac tissue cannot regenerate after injury. Its cells are not able to adapt to the adverse environmental changes. Cellular adaptation could be normal (physiological) or abnormal (pathological).

When cells are injured, one or two patterns will gradually occur; reversible cell injury leading to adaptation of the cells and tissues, or irreversible cell injury leading to cell death and tissue damage. Injured cells may accumulate materials including fat, cholesterol, protein, glycogen or pigment. When cells are irreversibly injured and dying, specific nuclear changes may be visible including pyknosis, karyrrhexis and karyolysis. If large number of cells dies, tissue necrosis may occur. Observable patterns of necrosis include; coagulative, liquefactive, fibrinous, gummatous, fat, gangrene and caseous necrosis.

The diagram below explains this sequence.

