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DEPARTMENT: NURSING SCI.

COURSE TITLE: CELLULAR PATHOLOGY

COURSE CODE: NSC 308

QUESTIONS: 1. Write explicitly on 5 diagnostic techniques used in pathology, relevant illustrations and examples required.

 2. Cellular Adaptation precedes cell death, discuss. Diagrams essential.

**ANSWERS**

1. The pathologist uses the following techniques to diagnose diseases:
* Histopathology
* Cytopathology
* Autopsy
* Hematological examination
* Cytogenetics
1. **HISTOPATHOLOGY:** 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% 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 facilitates differential staining with dyes and other reagents.

 Once the tissue arrives at the pathology department, the pathologist will exam it microscopically (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 which can be clearly seen under the microscope. The tissue is processed by putting it into different chemicals. It is then impregnated in paraffin, cut into thin slices & is finally stained. The stains can be Hematoxylin**/**Eosin stain or special stains such as PAS, Immunohistochemistry etc….

1. **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 for early detection and prevention of cervical cancer.
2. Diagnosis of symptomatic cancer. Cytopathology may used alone or in conjunction with other modalities to diagnose tumors revealed by physical or radiological examinations.

Advantages of cytologic examination compared to histopathological technique is because it is cheap, takes less time and needs no anesthesia to take specimens. Therefore, it is appropriate for developing countries with limited resources like Ethiopia. In addition, it is complementary to histopathological examination.

There are different cytopathologic 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 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. FNAC is cheap, fast & accurate in diagnosing many diseases.
2. **Exfoliative cytology:** refers to the 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:** refers to methods by which cells are dislodged by various tools from body surfaces (skin, mucous membranes, and serious membranes). E.g preparation of cervical smears with a spatula or a small brush to detect cancer of the uterine cervix at early stages.

**3. HEMATOLOGICAL EXAMINATION:** This is a method by which abnormalities of cells of the blood and their precursors in the bone marrow are investigated to diagnose the different kinds of anemia & leukemia

**4.** **CYTOGENETICS:** This is a method in which inherited chromosomal abnormalities in the germ cells or acquired chromosomal abnormalities in somatic cells are investigated using the techniques of molecular biology.

**5.** **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 tumors. FNAC & histopathology contribute much. However, for most diseases, diagnosis is based on a combination of pathological investigations.

 QUESTION 2

 Cellular adaptation is the changes made by a cell in response to adverse environmental changes. Adaptation may be physiologic or pathologic. There are various morphological adaptations and they include; **atrophy, hypertrophy, hyperplasia, and metaplasia.**

1. **ATROPHY:** Is a decrease in cell size. If enough cells in an organ undergo atrophy the entire organ will decrease in size. Thymus atrophy during early human development (childhood) is an example of physiologic atrophy. Skeletal muscle atrophy is a common pathologic adaptation to skeletal muscles disuse. Tissue and organs especially susceptible to atrophy include skeletal muscle, cardiac muscle, secondary sex organs and the brain.
2. **HYPERTROPHY:** Is an increase in cell size and volume. I f 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 (intracellular fluid) and other cytoplasmic components. For example, adipocytes (fat cells) may expand in size by depositing more lipid within cytoplasmic vesciles. Thus in human adults, increases in body fat occurs mostly by increases in the size of adipocytes, not by increases in the number of adipocytes. Hypertrophy may be caused by medical signals (e.g stretch) or trophic signals (e.g growth factors). 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.
3. **HYPERPLASIA:** Is an increase in the number of cells. It is the result of increased cell mitosis or division. The two types of physiologic hyperplasia are compensatory and hormonal. Compensatory hyperplasia permits 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 extent in bone, cartilage, and smooth muscles 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 women occurs in the endometrium and is called endometriosis.
4. **METAPLASIA:** occurs when a cell of a certain type is replaced by another cell type, which may be less differentiated. It is a reversible process thought to be caused by stem cell reprogramming. Stem cells are found in epithelia and embryonic mesenchyme of connective tissue. A prominent example of metaplasia involves the changes associated with the respiratory tract in response to inhalation of irritants, such as smog or smoke. The bronchial cells convert from mucus-secreting, ciliated, columnar epithelium to non-ciliated, squamous epithelium incapable of secreting mucus. These transformed cells may become cancerous if the stimulus (e.g cigarette smoking) is not removed. 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, ultimately protecting the esophagus from acid refux originating in the stomach. If stress persists, metaplasia can progress to dysplasia and eventually caricoma; Barrett’s esophagus, For example, can eventually progress to adenonocaricinoma.

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