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COURSE: NSC 308

QUESTIONS

- Write explicitly on 5 diagnostic techniques in pathology.
- Discuss cellular Adapation, with diagram.

ANSWER

DIAGNOSTIC TECHNIQUES IN PATHOLOGY

- Radiology
- Urinalysis
- Hematological test
- Flow cytometry
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Radiology

Radiology is the study of high-energy radiation used to examine and diagnose internal structures. The process of using radiology to make images is called radiography. Radiology in forensic anthropology is useful for documentation as well as detection and diagnostic applications and may include traditional two-dimensional radiography or computed tomography (CT). It can be used to produce a record of the condition of the remains at the time of examination, detect the presence of foreign material such as a bullet, and visualize internal skeletal structures that are not visible to the naked eye such as paranasal sinuses or developing dentition. It can also be used to diagnose conditions such as antemortem fractures or pathological conditions, or to see the placement of surgical implants.

Taking and examining radiographs requires some knowledge of the relative radiodensities of various materials. Keeping thickness as well as other technical parameters constant, the radiographic appearance of materials will vary as a function of their attenuation properties. This explains, for example, why it is possible to detect foreign material such as projectiles within bone or dental restorations using radiology—bullet lead and dental implements attenuate more X-rays (i.e., appears more radiopaque) than bone, making them appear distinct from bone (which attenuates more X-rays than soft tissues but less than lead) in a radiologic images.

Urinalysis

A Urinalysis is a test of your urine. A Urinalysis is used to detect and manage a wide range of disorder, such as urinary tract infections, kidney disease and diabetes.

A Urinalysis involves checking the appearance, concentration and control of urine. Abnormal Urinalysis results may point to disease or illness.

For example, a urinary tract infection can make urine look cloudy instead clear. Increased levels of protein in urine can be a sign of kidney disease.

Hematological test

Hematology is the branch of medicine concerning the study of blood, the blood-forming organs, and blood diseases. Hematology tests include laboratory assessments of blood formation and blood disorders.

Some examples of these tests are:

Full blood count - A count of the total number of red blood cells, white blood cells and platelets present in blood.

Blood film - Blood is smeared over a glass slide that is stained with specific dyes and viewed under a microscope. The number, shape and size of blood cells and the presence of any abnormal cells or immature cells are noted. The stain used for reticulocytes or immature red blood cells is Heilmeyer's reticulocyte stain. Staining may flag up abnormally shaped red blood cells such as sickle cells or spherocytes.

Staining may also detect blood parasites such as malaria, toxoplasmosis, and microfiliariasis.

Flow cytometry

Flow cytometry is a powerful tool that can be used in a significant number of cell analysis applications ranging from phenotyping to cell health and viability.

The two greatest advantages of flow cytometry are its ability to measure a large number of parameters (2 to 30 or more) on the same sample and its ability to collect information from millions of cells in a matter of seconds.

There are 3 main components of a flow cytometer—the fluidics, optics and electronics—that work together to provide a complete system of cell analysis.

For instance, Flow cytometry is used in the diagnosis of blood related cancers such as leukemia and lymphoma. Very specific monoclonal antibodies that have been treated with a fluorochrome are utilized to detect the presence or absence of various cellular components that are commonly seen in certain types of cancers. This information is used in the diagnosis, prognosis, and treatment of these diseases. This is especially useful in the early stages of a malignant disease where there may be only a few cancer cells present in the sample and these could go undetected by ordinary examination under a microscope.

Immunohistochemistry

Immunohistochemistry detect antigens in tissue sections by means of immunological and chemical reactions. The techniques is highly sensitive and specific and can detect a wide variety of antigens in multiple animal species.

(E.g. proteins) in cells of a tissue section. Immunohistochemistry (IHC) is a process used to diagnose some types of cancer including mesothelioma. The procedure involves locating antigens in biopsy tissue through the use of a visual marker. Common markers include fluorescent dye, enzymes, colloidal gold and radioactive elements. If cellular events associated with cancerous tumors – such as an increase in cell death – are evident in the tissue, then the abnormal activity will be highlighted by the stained tissue sample. Immunohistochemistry

cannot only help in the identification of a tumor, but it can also distinguish whether or not a tumor is benign or malignant.

2. CELLULAR ADAPTATION

Cells can adapt themselves by undergoing 5 different conditions.

- Hyperplasia
- Hypertrophy
- Atrophy
- Metaplasia
- Dysplasia

Atrophy

Atrophy is the opposite of hyperplasia and hypertrophy, in essence, it is the shrinkage of tissue. This can happen by a decrease in cell number and/or cell size.

Atrophy occurs physiologically in involution - when a tissue reduce in size after having increased in size. For example, the uterus and breasts both reduce in size post-pregnancy. Atrophy will also occur with **old age.** When an individual gets older, most systems and tissues undergo some level of atrophy.

Pathological atrophy can happen through **catabolic metabolism** due to **malnutrition**, whether this be caused by diseases such as **cancer** or by **nutritional deficit**. It can also occur due to inactivity, pressure, ischaemia, and chronic inflammation.

Metaplasia

Metaplasia is the **transformation of tissue** from **one type of cell to another**, for example a squamous epithelial cell to a cuboidal epithelial cell.

An example of **physiological** metaplasia is the **squamous metaplasia** that occurs in the **cervix**. When the cervix everts, the columnar epithelium that lines it meets the acidic environment of the vagina. The epithelium undergoes metaplasia to become stratified squamous epithelium like the rest of the vagina as this is better suited to the conditions. The area where this metaplasia happens is called the **transformation zone**.

Pathological metaplasia is a common response to **chronic stimulation** from chemical or physical factors. Metaplastic cells are often considered to be **precancerous**, as they can progress to form **malignant cells**, however, there is also the chance that the cells will regress to their original type if the stimulus is removed.

Some common examples of pathological metaplasia are:

Transformation of the **pseudostratified columnar** epithelium of the bronchi to **stratified squamous** epithelium in smokers due to cigarette smoke.

Squamous metaplasia of the **bladder** due to infection or urinary calculi.

Dysplasia

Dysplasia is the abnormal change in cellular shape, sized. The terms Dysplasia refers to as "disorganized growth"

In response to **physiological** and **pathological stimuli**, **cells** can **undergo changes** which make them more suited for their environment. Chemical mediators are able to signal cells to undertake a number of actions. These chemicals can prompt apoptosis, cell division and cell differentiation, or resist apoptosis.

Hypertrophy

Hypertrophy is the **increase** in the **size** of a tissue via the **enlargement of cells**. The intracellular organelles, cytoplasm and structural proteins all increase in these enlarged cells, but the number of cells in the tissue remains the same.

Hypertrophy can occur both physiologically and pathologically. A common cause of **physiological** hypertrophy is **increased skeletal muscle mass** gained through anabolic metabolism following exercise. Smooth muscle hypertrophy occurs in the **uterus**, stimulated by hormonal changes.

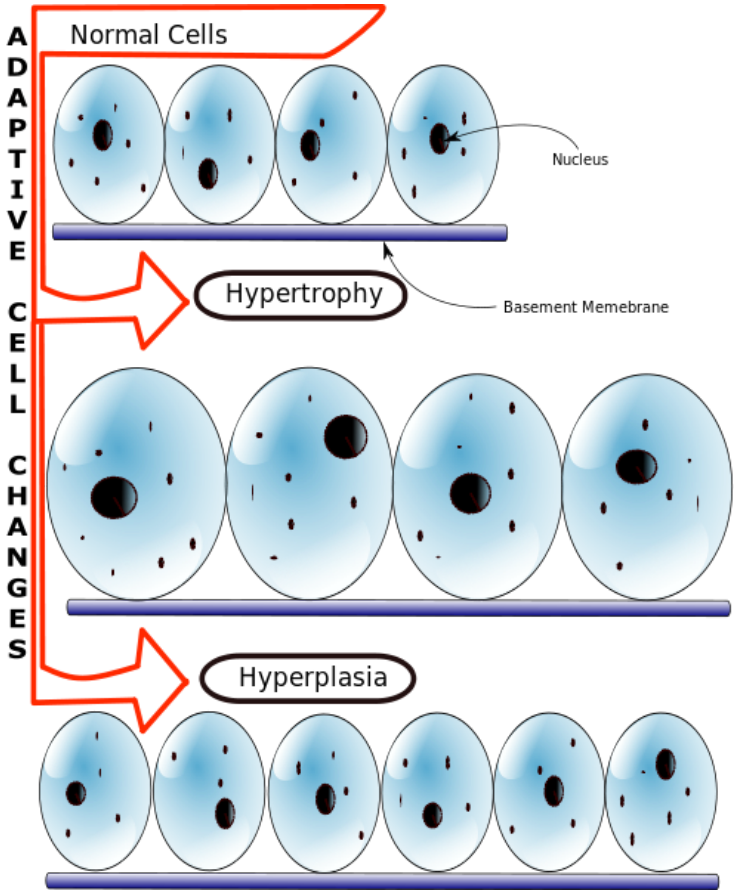
In **hypertension** there is often **pathological hypertrophy** of the **cardiac tissue**, due to the increased strain on the ventricles and atria of the heart. Too much cardiac hypertrophy can result in the muscular walls of the heart being too thick to effectively pump blood through the body causing heart failure.

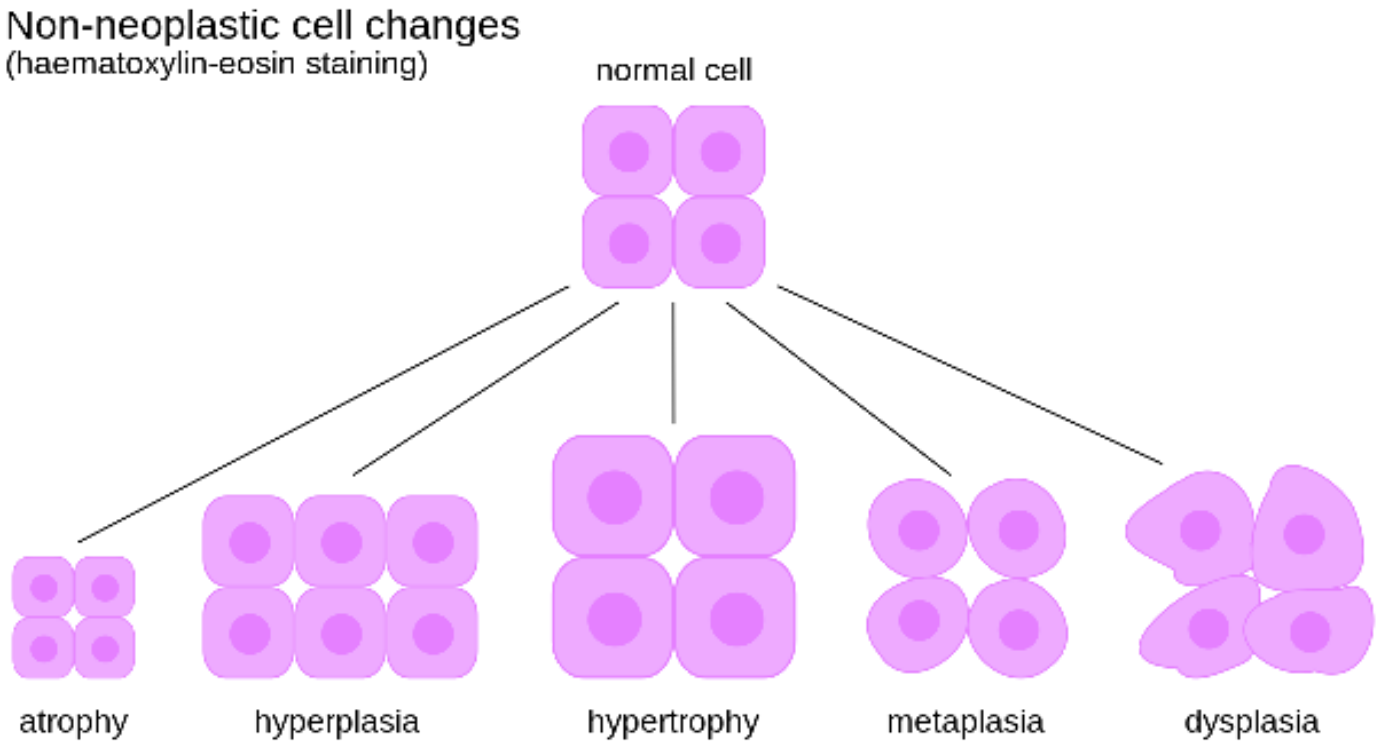
Hyperplasia

An Increase volume or number of cells, tissue, and organ.

Physiological hyperplasia occurs in the **endometrium** of the uterus upon stimulation of oestrogen during the **menstrual cycle**. Hyperplasia is also the method by which the **liver restores itself** from a partial resection.

Pathological hyperplasia can occur in **overstimulation** of **endometrial tissue** with oestrogen, for example in women taking unopposed oestrogen (without progesterone) for hormone replacement therapy after the menopause. The increased cell replication increases the chance of **dysplasia** (discussed later), and then neoplasia, taking place.


ADAPTIVE CELL CHANGES
Normal Cells
Nucleus
Basement Memebrane
Hypertrophy
Hyperplasia


Non-neoplastic cell changes
(haematoxylin-eosin staining)
normal cell
atrophy
hyperplasia
hypertrophy
metaplasia
dysplasia