**INTRODUCTION TO PATHOLOGY**

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Pathology is the “scientific study of disease”. It is the “scientific study of the molecular, cellular, tissue, or organ system response to injurious agents.

Disease is the “state in which an individual exhibits an anatomical, physiological, or biochemical deviation from the normal”. It may be defined as an abnormal  alteration of structure or function in any part of the body.

Pathology focuses on 4 aspects of disease:

1. **Etiology**: Cause of disease.
2. **Pathogenesis**: Mechanisms of development of disease.
3. **Morphology**: The structural alterations induced in cell and tissues.
4. **Functional Consequences**: Functional results of the morphologic changes, as observed clinically.

**Classification of Diseases**

1. Developmental – genetic, congenital.
2. Acquired:
a. Inflammatory – Trauma, infections, immune, etc.
b. Neoplastic – tumors cancers
c. Degenerative – aging.
d. Metabolic.
e. Iatrogenic: Drug induced.

**What should we know About a Disease?**

Regarding a disease process, we must be familiar with:

•    Definition of disease
•    Epidemiology – Where & When?
•    Etiology – What is the cause?
•    Pathogenesis – Evolution of disease
•    Morphology – Structural Changes
•    Functional consequences
•    Management
•    Prognosis
•    Prevention

**Morbid anatomy- (autopsy)- (post-mortem examination)**

This is one of the scientific ways in pathology to study diseases. ***It consists of external and internal examination of the body after death****.* It is through this important investigative technique of pathology that much information has been gained to help clarify the nature of many diseases. Morbid anatomy comprises both gross (naked eye) as well as microscopic examinations of the diseased organs and tissues. The post-mortemfindings enable the pathologist to reach the ultimate pathological diagnosis, to make a clinico-pathologic correlations and finally to deduce the cause of death.

**Microscopic and cellular pathology**

Pathology, and consequently medicine, was revolutionized by the application of microscopy to the study of diseased tissues from about the year 1800 AC. Light microscopy studies changes in diseased tissues at a cellular level. It has profoundly influenced our understanding of many diseases, as have the other branches of pathology.

**FIELDS OF PATHOLOGY**

Pathology is the foundation of medical science and practice. Without pathology, the practice of medicine would be reduced to legends and traditions.

**Experimental pathology** refers to the observation of the effects of manipulations on animal models or cell cultures regarding researches on human diseases.

**Clinical pathology**

Clinical pathology is more concerned with analysis of the disease itself that include

1-Its cause (etiology)

2-The mechanisms of its evolution (pathogenesis)

3-Its effects on various organs and systems of the body (Gross and microscopic

 pathology)

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**Subdivisions of clinical pathology**

In practice the major subdivisions of pathology are

1. **Histopathology**; concerned with the investigation and diagnosis of disease from gross and microscopic examination of tissues
2. **Cytopathology**; concerned with the investigation and diagnosis of disease from the examination of isolated cells
3. **Hematopathology**; concerned with the study of disorders affecting the cells and the coagulation system of blood
4. **Medical microbiology**; concerned with the study of infectious diseases and the organisms responsible for them
5. **Immunopathology**; concerned with the study of disturbances affecting the immune defense mechanisms of the body, and their contribution to the disease processes.
6. **Chemical pathology**; concerned with the study and diagnosis of diseases from the chemical changes that occur in tissues and fluids.
7. **Medical genetics**; concerned with the study of abnormal chromosomes and genes and their relevance to disease processes
8. **Toxicology;** concerned withthe study of the effects of known or suspected poisons on the body.
9. **Forensic medicine (pathology)**; concerned with the applications of pathology to legal purposes (e.g. investigations of death in suspicious circumstances)

Because of the continuous and rapid advances in the above subjects, it is impossible for one pathologist to cover all these branches. Thus each of these branches requires its own team of expert specialists; in fact there are currently specialists in the sub-braches of each of the disciplines mentioned above for e.g. in histopathology there are specialists in liver disease (hepatopathologist), in skin diseases (dermatopathologist) & in diseases affecting the nervous system (neuropathologist).

**Techniques of pathology**

Our knowledge of the nature and causation of diseases has been disclosed by the continuing application of various tools of pathology to their study.

**Histopathologic techniques**

***1. Gross pathology (macroscopic pathology)***

This refers to the changes affecting various organs and tissues in diseases as seen by the naked unaided eye. The gross pathology of many diseases is so characteristic that an experienced pathologist can give a fairly confident diagnosis of the disease before further investigation, for example, light microscopy is carried out.

***2. Light microscopy***

Advances in light microscopic examination have resulted in a wealth of information about the structure of tissues and cells in health and disease. If solid tissues (e.g. liver, kidney etc.) are to be examined by light microscopy, the sample must first be thinly sectioned to permit the transmission of light and to minimize the superimposition of tissue components. These sections are routinely cut from tissue hardened by permeation with and embedding in wax or, less often, transparent plastic. For some purposes (e.g. histochemistry, or when very urgent diagnosis is needed) sections have to be cut from tissue that has been hardened rapidly by freezing (frozen section technique). In either way, the sections are stained to help distinguishing between different components of the tissue (e.g. nuclei, cytoplasm, and other structures such as collagen). In addition to tissue sections, the microscope can also be used to examine cells (cytopathology) derived from

1. Fluid within cysts or body cavities (exfoliative cytology)
2. Scraped from body surfaces e.g. smears from the cervix uteri (exfoliative cytology)
3. Solid lesions through the use of needles (fine needle aspiration cytology).

In fact cytology is currently used widely in cancer diagnosis and screening.

***3. Histochemistry***

Certain cells produce chemical substances the detection of which through treatment with specific reagents (stains) is of diagnostic value; e.g. the periodic acid Schiff ‘s (PAS} stain used for the detection of glycogen and mucin and the Perl’s stain used for the detection of iron).

***4. Immunohistochemistry and immunofluorescence***

These techniques employ antibodies (with antigen specificity) to visualize substances (for e.g. cellular proteins or surface receptors) in tissue sections or cytological cell preparations. These antibodies are connected chemically to enzymes (in immunohistochemistry). Alternatively, fluorescent dyes (as in immunofluorescence) are used. Immunohistochemistry has become more popular than immunofluorescence because the latter requires a microscope modified for ultraviolet illumination and preparations are often not permanent because they fade with time.

In immunohistochemistry the end product is a deposit of opaque or colored material that can be seen with a conventional light microscope and does not deteriorate. The list of substances detectable by these techniques has been greatly enlarged by the development of monoclonal antibodies.

***5. Electron microscopy***

Electron microscopy has extended the range of pathology to

1. The study of disorders at an organelle (subcellular) level
2. The demonstration of viruses in tissue samples from some diseases.

The most common diagnostic use of electron microscopy is the interpretation of renal biopsies i.e. helps establish the diagnosis of various glomerular diseases (glomerulopathies).

**Learning pathology**

Pathology is best learnt in two stages:

1. **General pathology,** which is concerned with the causations, mechanisms and characteristics of the major categories of disease. (e.g. cell injuries and degenerations, inflammations, healing, neoplasia). The principles of general pathology must be understood before an attempt is made to study systemic pathology because it represents the foundation of knowledge that has to be acquired before indulging in the pathology of various systems of the body.
2. **Systemic pathology** is the study of various systems that comprise the body such as cardiovascular pathology, gastrointestinal pathology and so on. It includes the descriptions of specific diseases as they affect individual organs or organ systems (e.g. appendicitis, lung cancer, atherosclerosis etc,). Each specific disease can usually be attributed to the operation of one or more categories of causation and mechanism featuring in general pathology. Thus, acute appendicitis is acute inflammation affecting the appendix, whereas carcinoma of the lung is a neoplasia that results from carcinogens acting upon cells in the lung, and the behavior of the cancerous cells thus formed follows the pattern established for malignant tumors.