

Introduction to Pathology

COMPETENCY

PA 1.1 DESCRIBE THE ROLE OF A PATHOLOGIST IN DIAGNOSIS AND MANAGEMENT OF DISEASE

SHORT ANSWERS

1. Enumerate the various sub-divisions of pathology with their applications (3 marks)

1. Histopathology

- Branch of pathology that deals with gross and microscopic examination of surgically obtained tissue

2. Cytopathology

- Branch of pathology that deals with cytomorphology of specimens obtained by aspiration or exfoliation

3. Hematology

- Branch of pathology dealing with blood and bone marrow studies

4. Clinical pathology

- Branch of pathology dealing with chemistry of body fluids

5. Forensic pathology

- Branch that deals with study of tissues obtained by autopsy

6. Molecular pathology

- Branch dealing with molecular techniques in pathology

7. Immunohematology and blood banking

- Branch of hematology that deals with transfusion pathology and blood banking services

2. Discuss the role of pathologist in contemplating diagnosis and management of diseases. (3 marks)

Pathologists play a vital role in diagnosis and management of diseases by performing the following actions:

1. Identification of the disease process as inflammatory/neoplastic/metabolic/congenital
2. Sub-categorization of the disease process like neoplastic are further grouped into benign/borderline/malignant
3. Preoperative assessment of lesions using cytological techniques

4. Screening for cancers using cytological techniques
5. Intraoperative consultation for nature of lesions, margin clearance, etc.
6. Detection of biochemical and hematological alterations in diseases
7. Recommendations for disease management including further investigations required for confirmation
8. Detection of molecular determinants of disease etiology, pathogenesis, prognosis and response to therapy

COMPETENCY

PA 1.2 ENUMERATE COMMON DEFINITIONS AND TERMS USED IN PATHOLOGY

SHORT ESSAY

1. Enumerate the commonly used definitions and terminologies in pathology. (5 marks)

1. Etiology

- Cause of a disease or disorder

2. Pathogenesis

- Pathogenesis is the mechanism through which the underlying cause leads to the pathological and clinical changes

3. Morphologic changes

- The morphologic changes are the alterations in structure occurring due to the pathogenetic mechanisms. The structural changes in the organ can be seen with the naked eye (gross features) or they may only be seen under the microscope (microscopic features)

4. Disease

- A disease may be defined as a "state in which an individual exhibits a physiological, or biochemical deviation from the normal." or "any deviation from or interruption of the normal structure or function of any part"

5. Prognosis

- Refers to the probable outcome of a disease in a living individual. It is the clinician's estimate of the severity and possible result of a disease

6. Acute

- Characterized by a sudden onset or rapid course

7. **Chronic**

- Slow onset or long duration

8. **Idiopathic**

- Any disease that is of uncertain or unknown origin may be termed idiopathic

9. **Course of a disease**

- The course of a disease, also called its natural history, refers to the development of the disease in a patient, including the sequence and speed of the stages and forms they take

10. **Syndrome**

- A syndrome is a set of medical signs and symptoms and collection of diseases which are not correlated with each other and often associated with a particular disease or disorder

COMPETENCY

PA 1.3 DESCRIBE THE HISTORY AND EVOLUTION OF PATHOLOGY

SHORT ESSAYS

1. Discuss the history and evolution of pathology. (5 marks)

- There is no single event that demarcates the beginning of pathology and has roots in common with all other medical specialties
- History of pathology spans over 4000 years. Various archaeological discoveries, museums around the world furnish a wealth of observations of gross features of disease from prehistoric people to the present time

17th century BC/Egyptian Medicine

- Edwin Smith Papyrus really began documentation of disease with records containing information on different types of bone injuries, trachoma, ulcerating lumps (cancer?), parasites and other diseases
- Egyptians' pathology did not develop any systemic knowledge of disease phenomena or underlying processes

Last Three Centuries BC

- Alexandrian Greeks, heavily influenced by Hippocrates made lasting contributions to anatomy and pathology
- Hippocrates of Cos (460–370 BC), with his humoral theory of the nature of disease influenced medicine until the renaissance and beyond
- Humoral theory—body is composed of 4 humours (blood, phlegm, yellow bile, black bile) and imbalance of humours was cause of disease
- Hippocratic workers gave remarkably clear descriptions of many pathological features, such as wound inflammation, tumours, haemorrhoids, malaria and tuberculosis
- First dissections of humans
- Herophilus is believed to be among the first to pursue anatomy as a science, to correlate structure with disease

Roman Medicine (30 BC–38 AD)

- Aristotle believed the heart to be central organ of body and conducted animal dissections and described anatomical structures
- Cornelius Celsus wrote *De Re Medicina* in eight volumes Book III contains the classic definition of inflammation: “*Notae vero inflammationis sunt quatuor, rubor et tumour, cum calore et dolore*”, until now learned by every medical student and described classical signs of inflammation; rubor (redness), tumour (swelling), calor (warmth) and dolor (pain)

First Century AD

- Few new developments
- Human dissections ceased to be performed

Second Century

- Claudius Galen (129–201 AD), considered as the greatest medical figure followed Greek concepts including Hippocratic theory of four humours
- Galen described ‘crab-like’ growth of cancer
- He attributed to adding a ‘fifth sign of inflammation, either ‘loss of function’ or throbbing/pulsation
- Galen’s views on pathology are found in his books ‘seats of diseases’ and ‘abnormal tumours’ and his writings directed medicine for over a thousand years into middle ages

Period between Galen and Late Middle Ages

- Influenced by Arab and Byzantine physicians
- Aetius of Amida (502–575) left excellent descriptions of carcinoma of the uterus, haemorrhoids, condylomata, fissures and ulcers (cancers?) of rectum
- 14th and 15th Centuries
- Bologna practiced human dissections as regular part of medical teaching for study of anatomy and also to study disease and legal aspects of death
- Dissections became increasingly common attempting to substantiate theories of Galen

End of 15th Century

- Pathology took wing as a separate specialty
- Antonio Benivieni (1443–1502), who recorded case histories and performed autopsies on some of his patients. After his death, 111 cases, among which were 20 post-mortems, were published in a little classic: “*De Abditis Nonnullis ac Mirandis Morborum et Sanationum Causis*” (About the Hidden Causes of Disease), one of the first pathology works
- Andreas Vesalius (1555), founder of modern human anatomy, dissected bodies of executed criminals with hands-on direct observation of body and published work on findings from human autopsies ‘the anatomical view of the body’, one of the earliest anatomy books.

16th Century

- Several brilliant and renowned anatomists became increasingly aware of the pathological structures

that they encountered during anatomical studies and whose names are still used in daily pathology practice

- Jean Fernel (1497–1558) presented his work as “Medicina” and in one of its parts segregated diseases into categories of general and special diseases
- He diagnosed at autopsy a case of acute appendicitis, and was one of the first to suggest the syphilitic origin of some aneurysms

17th Century

- William Harvey (1578–1657) with his publication of “De Motu Cordis et Sanguinis”, in 1628, revolutionised medicine and concepts of disease causation.
- Harvey described circulation of the blood through pumping of heart
- Harvey also made important observations on the pathologic heart: ventricular rupture and left-sided hypertrophy in a patient with aortic valve insufficiency
- First illustrations of disease processes or pathologic changes is various drawings by surgeons
- Theophile Bonet (1620–1689) collected case descriptions of autopsies from the last two centuries in two 1,700 page volumes contain a remarkable 3,000 autopsy reports, arranged in anatomical sections “from head to toe”, with comments and references

18th Century

- More sophisticated through abundance of autopsies and pathologic observations were published in textbooks and journals
- Giovanni Batista Morgagni (1682–1771), a medical student, gained instant fame with his first important book, “Adversaria Anatomica”
- Morgagni described 640 autopsies, structurally correlating the symptoms of his patients with the pathological findings at autopsy and it became generally accepted that diseases were organ based
- John Hunter (1728–1793) was author of numerous papers to the Royal Society on exceedingly diverse topics that might be described as experimental pathology, including the use of primitive microscopes.
- Hunter described inflammation, regarding it first as a defensive mechanism, and second as a reparative process.
- Marie Francois Xavier Bichat investigating fresh bodies, by simple methods without use of microscope was able to identify 21 types of tissues, improving foundation for tissue-based disease
- Thomas Hodgkin (1798–1866) described pathological changes in tissues and published a paper using microscope
- Edward Jenner, father of immunology and pioneer of smallpox vaccine
- Diagnostic histopathology became more and more important especially in area of neoplasia and stimulated development of pathology as separate ‘specialty’

- Microscopes changed concepts of disease from whole organs to focus upon cells
- Methods of embedding techniques, fixing tissues, microtomes, biological stains evolved
- Edwin Klebs introduced paraffin embedding improving embedding process, hardening and dehydration

19th Century Onwards

- New technology shaped the future of pathology, use of microscope grew exponentially, a microscope era
- Carl von Rokitansky (1804–1878) and Rudolf Virchow (1821–1902) used microscopes routinely in autopsy studies
- Rudolf Virchow, greatest figure in history of pathology, used microscope for tissue analysis from autopsies and initiated idea that changes in diseased states can be traced to alterations in cells (father of cellular pathology)
- Specialty of pathology entered a new era in the second half of the nineteenth century
- In medical schools throughout Europe, ‘Inspectors of the Dead’ and ‘Curators of Museums’ began to be replaced by Lecturers in Morbid Anatomy, then by Professors of Pathology.
- Many of these new professors promptly used the opportunity to claim their own department or building
- Friedrich von Recklinghausen (1833–1910) remembered for his description of ‘multiple neurofibromatosis’, was a masterly investigator of bone pathology, both primary and secondary bone growths
- He published important studies on thrombosis, embolism, infarction, degenerations, haemochromatosis, adenomyomata of the uterus, and other many other pathologic conditions.

20th Century

- Pace of research in pathology accelerated and number of discoveries grew exponentially
- Sternberg (1898)—reed (1902) recorded basic features of histopathology exemplifying use of microscope in pathologic research and diagnosis
- Ludwig Aschoff (1866–1942) developed concept of reticulo-endothelial system
- Nikolai Anitshkov (1855–1964) described histopathology of heart in rheumatic fever and proposed role of cholesterol in atherosclerosis
- Karl Landsteiner (1868–1943) noted for development in 1901 of the modern system of classification of blood groups from his identification of presence of agglutinins in blood, identified the Rh factor in 1937 with Alexander S Weiner which led to new fields of blood transfusion and tissue transplantation. Nobel prize winner 1930.
- Electron microscopy

20th Century to Present

- Pace of discovery and change has accelerated
 - Ongoing advances in fields of embedding, cutting, fixation, immunohistochemical staining, monoclonal antibodies, cytogenetics, molecular methods, microscopy and image processing
 - Revolutionary discoveries like polymerase chain reaction (PCR), immunofluorescence techniques and molecular biology (genomics)
- 2. Name the important scientists who have contributed to the evolution of pathology and outline their significant contributions. (5 marks)**

Important Scientists in the Field of Pathology and their Contributions

Hippocrates of Kos

- Greek physician, father of western medicine
- Body composed of 4 humours ('humourism')
 1. Blood—sanguine
 2. Phlegm—phlegmatic
 3. Yellow bile—choleric
 4. Black bile—melancholic
- Imbalance of these humours was the cause of disease

Cornelius Celsus

Classic definition of inflammation—rubor (redness), tumour (swelling), calor (warmth), dolor (pain).

William Harvey

- Revolutionized concepts of disease causation
- Described circulation of the blood through the pumping of the heart
- Observed cardiac pathology—ventricular rupture

Paul Ehrlich

- "Father of Hematology"
- Compared textile dyes and cell staining

Karl Landsteiner

Discovered blood groups A, B and C (O)

SHORT ANSWER

- 1. Identify the scientist shown below and enlist his contributions to the field of Pathology. (3 marks)**

Scientist

Portrait of Rudolph L.K. Virchow (1821–1902)



Contributions to the Field of Pathology

1. Used the microscope for tissue analysis from autopsies
2. One of the first physicians to examine disease at the cellular level, believing that most diseases, including pathological thrombosis, were caused by cellular pathology.
3. Initiated the idea that changes in diseased states can be traced to alterations in cells
4. The 'father' of cellular pathology
5. He was the first person to recognize leukemia
6. Virchow's triad include intravascular vessel wall damage, stasis of flow, and the presence of a hyper-coagulable state.