By the Name of ALLAH the Most Gracious the Most Merciful

Tissue Biopsy

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Bailey & Love's Short Practice of Surgery, 27th Edition . CH 16 . P 234

LEARNING OBJECTIVES

- To understand:
- • The value and limitations of tissue diagnosis
- • How tissue samples are processed
- • The role of histology and cytology
- To be aware of:
- • The role of additional techniques used in clinical practice, including special stains, immunohistochemistry and molecular pathology.
- • The principles of microscopic diagnosis, including the features of neoplasia.
- • The importance of clinicopathological correlation.
- • Management issues.

Introduction

- Tissue analysis & diagnosis .
- Examination of human tissue from autopsies and surgical procedures (biopsies) .
- Screening programmes .
- Macroscopic & Microscopic (histopathology) examination .
- The specialty variably known as Histopathology, Anatomic Pathology or Cellular Pathology, encompasses histopathology, cytopathology, autopsy work and molecular pathological tissue diagnosis.
- Multidisciplinary clinical management meetings.
- The interpretation of microscopic and molecular changes is enhanced considerably by correlation with the clinical picture and the macroscopic findings.

Reasons for tissue analysis

- To make a new diagnosis
- To confirm a suspected or established clinical diagnosis
- To exclude additional diagnoses
- To assist with prognosis
- To stage tumours
- To help select therapy and plan management
- To assess response to treatment
- Audit

TISSUE SPECIMENS

Common types of tissue sample

I. **Histology** (for diagnosis and assessment)

A. *Formalin-fixed tissue*

i. Biopsy

Mucosal
Punch
Needle (core) } (small biopsy)
Curettings
Incisional
Excision

ii. Resection (remove a lesion , manage a related problem, diagnosis, staging, and determination of further management)

B. *Fresh tissue* (for frozen section)(intraoperatively, rapid answer, less accuracy and precision of diagnosis)

II. **Cytology** (smeared immediately onto glass slides, fixed with alcohol or air dried and stained)

Cervical
Washings, brushings, scrapes
Fine-needle aspirate (FNA)
Fluids/sputum

All samples for routine histology are immediately placed in a fixative, usually formalin (10% formaldehyde), to preserve morphology.

Ultrasound-guided and computed tomography (CT)-guided biopsies of focal and less accessible lesions

PRINCIPLES OF MICROSCOPIC DIAGNOSIS

- Diagnosis of Malignancy.
- Non-neoplastic and inflammatory conditions .
- Features of inflammation .

Diagnosis of Malignancy

Microscopic features of malignancy

Histological types of malignancy

Prognostic factors for malignant tumours

Diagnosis of Malignancy

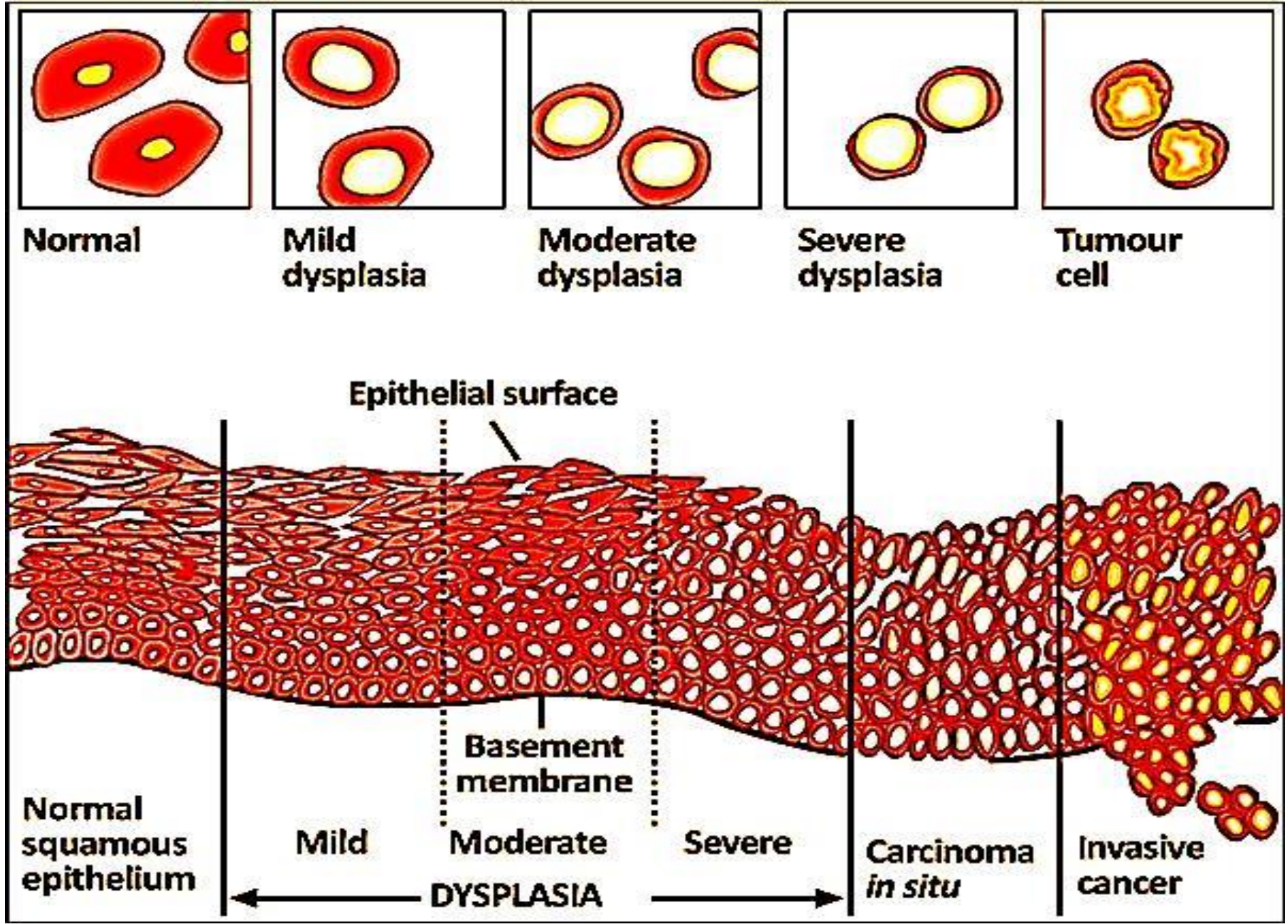
Microscopic evidence of aggressive behaviour (Histological)

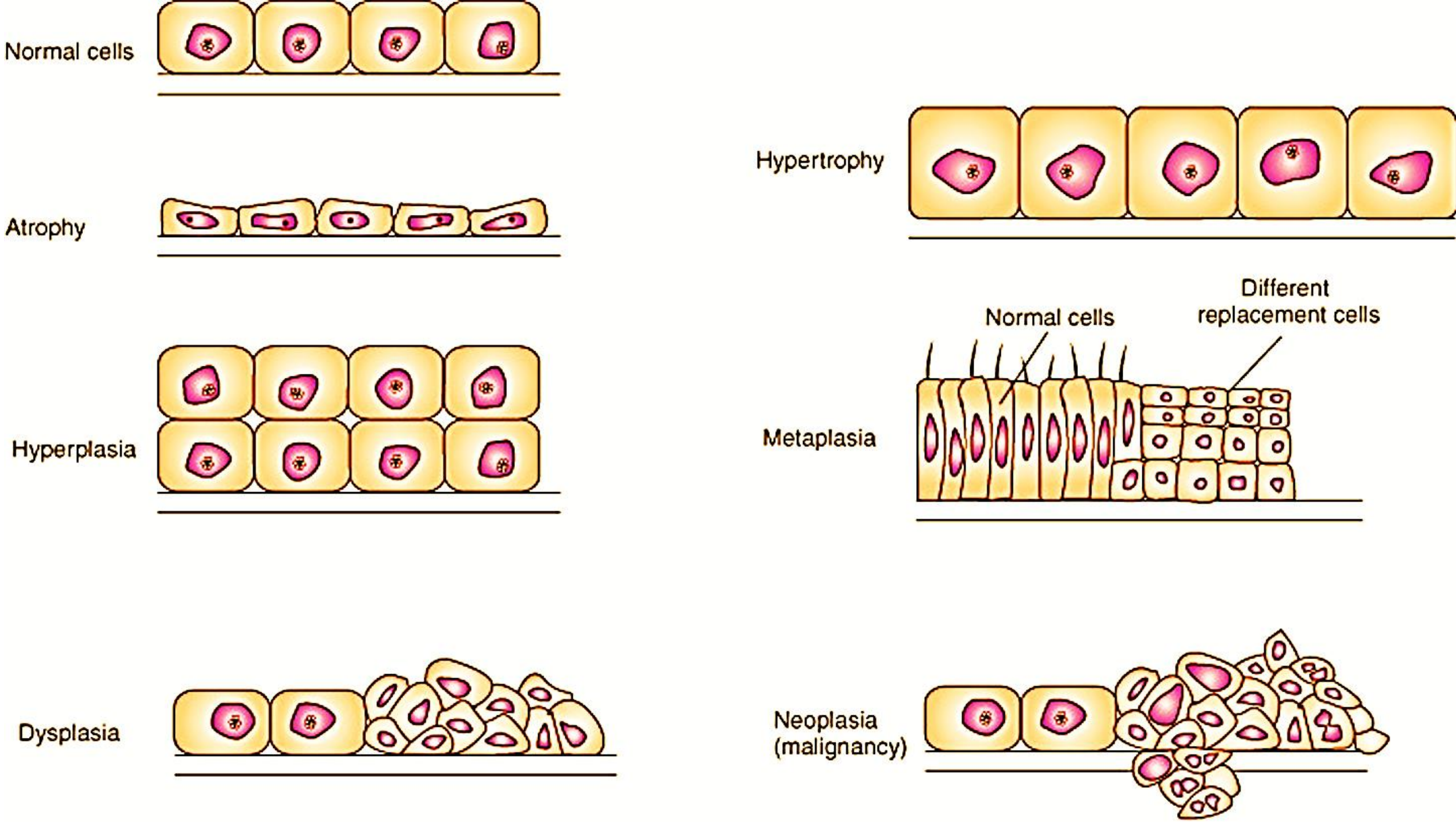
- Metastasis.(L.N.,organs …..).
- Invasion of surrounding structures, perineural invasion and vascular invasion.
- Derangement of the usual architecture, an increased number of mitotic figures, atypical mitoses and necrosis (tissue death).

Microscopic changes at the cellular level (cytological changes)

- nuclear enlargement, an increased nuclear:cytoplasmic ratio, nuclear pleomorphism (variation in shape) nuclear hyperchromasia (dark colour) and Chromatin clumping . Multiplicity, irregularity and enlargement of nucleoli .

- Additional techniques such as immunohistochemistry and clonality studies may help to confirm neoplasia or malignancy (see below).
- The term ‘dysplasia’ usually indicates that microscopic features of carcinoma, or similar to those of carcinoma, are present but that invasion has not occurred, e.g. cervical intraepithelial neoplasia (CIN), colorectal dysplasia


Normal
Mild dysplasia
Moderate dysplasia
Severe dysplasia
Tumour cell
Epithelial surface
Basement membrane
Normal squamous epithelium
Mild
Moderate
Severe
DYSPLASIA
Carcinoma in situ
Invasive cancer


Normal cells
Atrophy
Hyperplasia
Dysplasia
Hypertrophy
Metaplasia
Normal cells
Different replacement cells
Neoplasia (malignancy)

Histological types of malignancy

- Eepithelial differentiation, and typically arising in an epithelial layer, is a carcinoma.

  As squamous cell carcinoma if it shows evidence of keratinisation ,adenocarcinoma if it shows evidence of glandular differentiation (in the form of tubule formation and/or mucin production) ,neuroendocrine carcinoma/small cell carcinoma (usually requiring immunohistochemical confirmation), clear cell carcinoma or one of many other types.

- Malignant melanoma (melanocytes) .
- Lymphoma (lymphoid cells) .
- Sarcoma (mesenchymal cells).

Prognostic factors for malignant tumours

- Grading :Degree of differentiation (Well-differentiated and poorly differentiated)
- Stage : AJCC (American Joint Committee on Cancer) staging schemes depend heavily on the histopathological TNM (Tumour Node Metastasis)(S I, II , III, IV).
- Vascular invasion and perineural invasion.
- Positive resection margins.
- Tumour markers

Non-Neoplastic and Inflammatory Conditions

- All specimens are examined thoroughly in order to confirm the suspected clinical diagnosis and also to exclude other conditions that are not necessarily apparent to the surgeon.
- Correlation with the clinical picture .

Microscopic Features of Inflammation

- Acute inflammation is characterised by neutrophils.
- Chronic inflammation is characterised by lymphocytes and plasma cells.
- Other inflammatory cells include eosinophils, mast cells and histiocytes.
- Granulomas (i.e. collections of epithelioid histiocytes) raise the possibility of mycobacterial infection, fungal infection, sarcoid, Crohn's disease or a reaction to foreign material, among numerous possible causes.
- Eosinophils in large numbers may reflect parasitic infection or allergy.

Other Terms

- hyperplasia means an increase in cell number .
- hypertrophy refers to an increase in cell size.
- Atrophy encompasses a reduction in cell number and/or cell size.
- Metaplasia describes the change from one mature cell type to another, e.g. columnar metaplasia in the oesophagus (known as Barrett's oesophagus) where squamous epithelium is replaced by gastric or intestinal type epithelium.
- Necrosis refers to cell or tissue death, typically as a result of external factors, and is often associated with cell swelling and in}ammation.
- Apoptosis is a process of programmed cell death that occurs in normal cells as a result of internal signals, and typically causes cell shrinkage and nuclear chromatin condensation.
- Hammertoma.

Anaplasia (structural differentiation loss within a cell or group of cells).
Aplasia (organ or part of organ missing)
Desmoplasia (connective tissue growth)
Dysplasia (change in cell or tissue phenotype)
Hyperplasia (proliferation of cells)
Hypoplasia (congenital below-average number of cells, especially when inadequate)
Metaplasia (conversion in cell type)
Neoplasia (abnormal proliferation)
Prosoplasia (development of new cell function)

Abiotrophy (loss in vitality of organ or tissue)
Atrophy (reduced functionality of an organ, with decrease in the number or volume of cells)
Hypertrophy (increase in the volume of cells or tissues)
Hypotrophy (decrease in the volume of cells or tissues)
Dystrophy (any degenerative disorder resulting from improper or faulty nutrition)

ASSESSMENT

- Histological assessment
- Cytological assessment

- Light Microscopy.
- Additional techniques :
  - Special stains.
  - Immunohistochemistry.
  - Electron microscopy.
  - Molecular pathology.
  - In situ hybridisation, including fluorescence in situ hybridisation (FISH) .
  - PCR-based technique.

ASSESSMENT

Light Microscopy : A low-power lens allows a sample to be scanned and its overall architecture to be assessed, while a high-power lens allows a closer and more detailed view. Polarisation can be used to detect foreign material (e.g. sutures) or to assess a special stain (e.g. Congo red).

- Histological assessment
- Cytological assessment

Histological assessment

- The microscopic structure of the tissue is preserved, allowing direct visualisation of architecture. Accordingly, the pathologist can see not only the characteristics of the cells that form the tissue, but also the way in which these cells are related to one another and the way in which different tissue compartments are arranged.

Cytological Assessment

- A cytological preparation consists of a sample of cells. *Architecture* cannot be determined, because intact tissue is absent or sparse.
- The assessment relies mainly on the characteristics of the cells themselves.
- It may be difficult to diagnose malignancy because many of the criteria, particularly invasiveness, cannot be assessed.
- However, cytology has several potential advantages over histology. A wider area may be sampled, and obtaining a specimen may be easier and less traumatic. Processing times are usually shorter and costs lower. Also, non-medical staff can be trained to report the cases, particularly cervical smears .

Cytology compared with histology

Advantages:

- Wider area may be sampled .
- Sampling may be less invasive.
- Fast .
- Cheap.

Disadvantages:

- Cannot assess tissue architecture.
- Less amenable to further studies.

Screening Programmes

It aims to detect and treat premalignant tissue changes, e.g. dysplasia, or early stage malignancy (rather than advanced disease). They may rely on cytology, histology or both.

- The cervical cancer programme, which currently uses cytology initially, with biopsy and histology follow-up if appropriate.
- The breast cancer screening programme may use cytology and/or histology.
- the bowel cancer screening programme relies initially on a non-tissuebased test followed, if appropriate, by endoscopy and, where required, biopsy and histology.
- Screening for cancer in ulcerative colitis relies on endoscopic assessment and histology.
- Screening for CA oesophagus.

Specimen inadequacy

Cytology:

- Failure to sample the intended organ or lesion.
- Sample too limited .
- Non-viable tissue.(center of a necrotic or ulcerated lesion)

Histology:

- Sample too superficial.
- Cautery artifact.
- Crush artifact.

AUTOPSY : As identifying the cause of death.

1- The coroner's postmortem :when the coroner decides that there is a need, or is obliged, to establish the cause of death. No consent from relatives is required.

2- The hospital autopsy : which requires relatives' consent. Valuable information may be revealed through both of these routes, especially in the unusual event of death following surgery.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