Neoplasia

Neoplasia: is uncoordinated and uncontrolled cell growth and division resulting in **new growth formation**.

Tumour originally described swelling that can be caused by a number of conditions, including inflammation, but it is now increasingly being used to describe a neoplasm.

Oncology (Greek onkos = tumour) is the study of tumours or neoplasms.

Both **neoplasia** and **hyperplasia** cause an increase in an organ or tissue size due to increase number of cells. However, the cell changes that occur with neoplasia are uncoordinated and lack normal regulatory controls over cell growth and division.

So, what are the main differences between neoplasia and hyperplasia?

Neoplasia vs hyperplasia

Neoplasia	Hyperplasia
It is uncoordinated and uncontrolled cell growth and division resulting in new growth formation.	It is an increase in the number of cells in an organ or tissue, usually resulting in increased volume of the organ or tissue.
It is induced by stimulus but usually unknown.	It occurs either due to physiological or pathological conditions.
The growth is uncontrolled.	The growth is limited and can stop when remove the stimulus.
Cancer cells differ from the original tissue and abnormal in shape and pattern.	Hyperplastic cells resemble tissue of origin normal in shape and pattern.

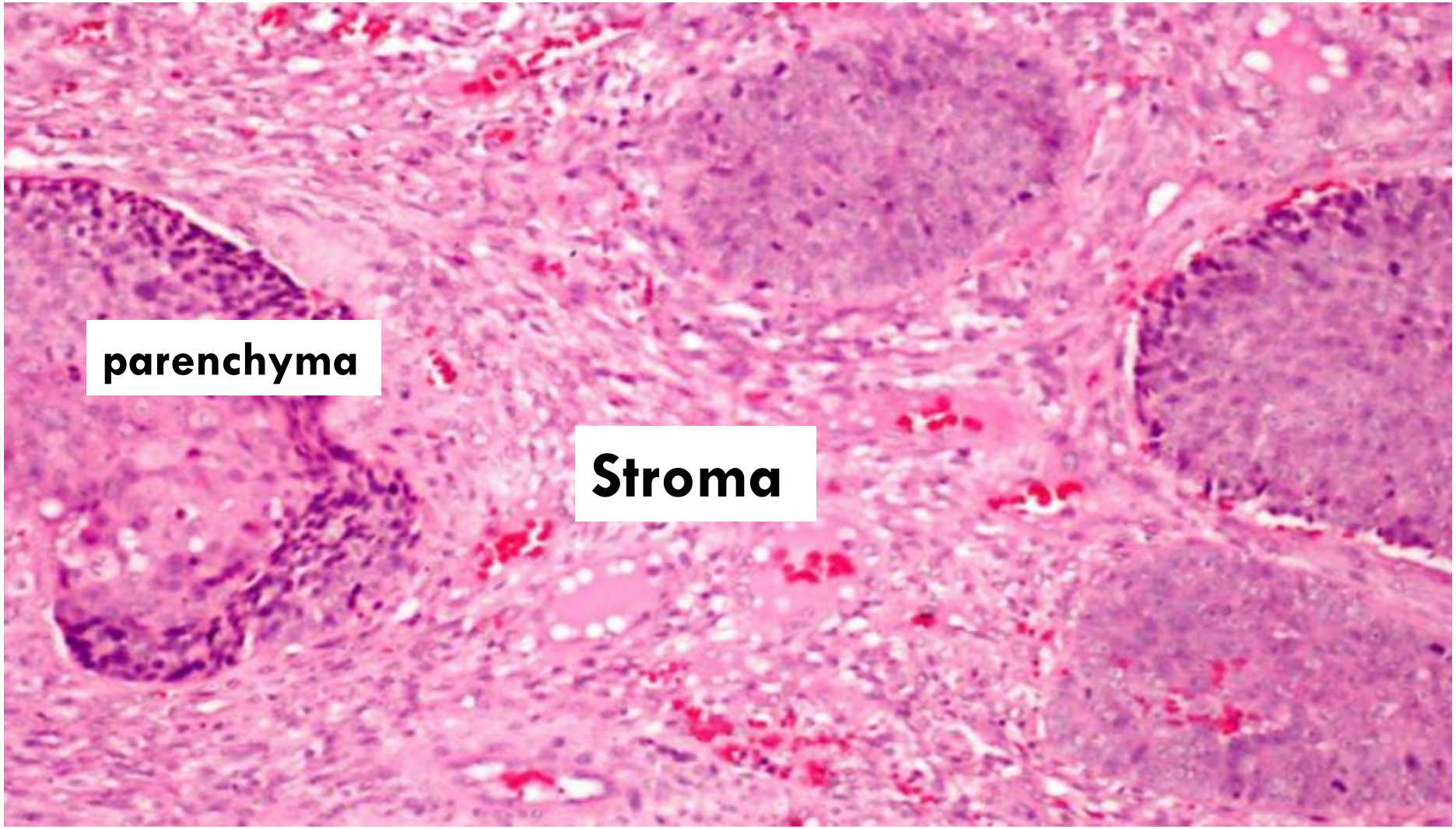
The basic components of tumour

All tumours have two basic components:

(1)The parenchymal tissue: It is made up of **neoplastic cells** of a tumour. The parenchymal tissue determines the **behaviour** and **classification** of tumours.

(2) The stroma (supporting) tissue: It is made up of **connective tissue and blood vessels**. The stroma determines the **growth** and **spread** of tumours. **Therefore, the stroma is essential to the growth of the tumour.**

Parenchyma vs Stroma



Classification of tumours

Classification of tumours is based on:

1. The behaviour: tumors can be **benign, malignant and locally malignant**.

2. The origin of tissue (histology): tumours mainly arise either from **epithelial tissue** or **non-epithelial tissue (mesenchymal tissue)**.

3. Degree of differentiation: differentiation refers to the extent to which neoplastic cells resemble normal cells, both morphologically and functionally.

Benign tumours are **well differentiated**, e.g. the neoplastic cells of a **lipoma**, a proliferation of benign **adipocytes**, may so closely resemble normal adipocytes.

Malignant tumours are characterized by wide changes of cell differentiation from **well differentiated, poorly differentiated or undifferentiated (anaplasia) cells.**

Nomenclature of Benign tumors

Benign tumours usually are named by adding the **suffix-oma** to the parenchymal tissue type from which the growth is originated.

Benign tumours originate from epithelial tissue:

Papilloma is a benign tumour arising from an **surface epithelial tissue.**

Adenoma is a benign tumour arising from **glandular epithelial tissue**.

Benign tumours originate from non-epithelial tissue

Fibroma is a benign tumour arising in **fibrous tissue.**

Lipoma is a benign tumour arising in **adipose tissue.**

Chondroma is a benign tumour arising in **cartilage.**

Osteoma is a benign tumour arising in **bone.**

Leiomyoma is a benign tumour arising in **muscle.**

Neuroma is a benign tumour arising in **nerve cell.**

Nomenclature of malignant tumors

1. Malignant tumours originate from epithelial tissue:

Carcinoma is a malignant tumour arising from an **surface epithelial tissue** which cover the internal organs and outer surfaces of your body.

Adenocarcinoma is a malignant tumour arising from an **glandular epithelial tissue**.

Malignant tumours originate from non-epithelial tissue:

Sarcomas is a malignant tumour arising from **connective tissue.**

E.g. A cancer of **fibrous tissue** is a **fibrosarcoma** and a malignant tumour composed of **chondrocytes** is a **chondrosarcoma**.

There are some examples contrary to this concept such as **melanoma** for carcinoma of the melanocytes, **hepatoma** for carcinoma of the hepatocytes, **lymphoma** for malignant tumour of the lymphoid tissue and **Leukaemia** is the term used for cancer of blood forming cells.

Characteristic features of benign tumours

1. Benign tumours are composed of **well-differentiated cells** that **resemble** the cells of the tissues of origin.

2. They are generally characterized by a **slow, progressive rate of growth** that may come to a **standstill or regress**.

3. They remain **localized** to their site of origin and do not have the capacity to infiltrate, invade, or metastasis to distant sites.

4. Because the benign tumours grow slowly by **expansion**, they surrounded by connective tissue called a **fibrous capsule.** This capsule is responsible for a sharp **line of demarcation** between the benign tumour and the adjacent tissues, a factor that facilitates surgical removal.

Characteristic features of Malignant tumour

1. Malignant tumours are composed of **undifferentiated cells, with anaplasia and atypical structure.**

2. They can grow **rapidly**, **invade and destroy** adjacent structures.

3. They can spread to distant sites **(metastasis).**

Metastasis is the development of a secondary tumour in a location distant from the primary tumour. The cells detach from the original tumour mass, invade the surrounding tissue, and enter the blood and lymph system to spread to distant sites.

4. They **lack a capsule** and their margins are not clearly separated from the normal surrounding tissue. The lack of a sharp line of demarcation separating them from the surrounding tissue makes the complete surgical removal of malignant tumours more difficult than removal of benign tumours.

5. As malignant tumours grow, they may also compress and erode blood vessels, causing ulceration and **necrosis** along with **hemorrhage**.

Characteristics of Benign and Malignant Neoplasms

Features	Benign	Malignant
Rate of growth	Usually progressive and slow; may come to a standstill or regress	Variable and depends on level of differentiation; the more undifferentiated the cells, the more rapid the rate of growth
Mode of growth	Grows by expansion without invading the surrounding tissues; usually encapsulated	Grows by invasion, sending out processes that infiltrate the surrounding tissues
Metastasis	Does not spread by metastasis	Gains access to blood and lymph channels to metastasize to other areas of the body

Clinical and gross features of benign and malignant tumors

Clinical and gross Features	Benign	Malignant
1. Boundaries	Encapsulated	lack a capsule
2. Surrounding tissue	Often compressed	Usually invaded
3. Size	Usually small	Often larger
4. Secondary changes	Occur less often	Occur more often

Microscopic features of benign and malignant tumors

Microscopic Features	Benign	Malignant
Degree of differentiation	Well-differentiated cells that resemble cells in the tissue of origin	May be well differentiated, poorly differentiated or undifferentiated (anaplasia) cells.
Nucleo-cytoplasmic ratio	Normal	Increased
Hyperchromatism	Absent	Often present
Mitoses	May be present but are always typical mitoses	Mitotic figures increased and are generally atypical and abnormal
Pleomorphism (variation in cell size and shape)	Usually not present	Often present
Function	Usually well maintained	Because of their lack of differentiation, cancer cells tend to function on a more primitive level than normal cells, retaining only those functions that are essential for their survival and proliferation.

Categories of malignant tumour

There are two categories of malignant tumour

Solid tumours are initially confined to a specific tissue or organ. As the growth of the primary solid tumour progresses, cells detach from the original tumour mass, invade the surrounding tissue, and enter the blood and lymph system to spread to distant sites.

Hematologic cancers involve cells normally found within the blood and lymph, thereby making them disseminated diseases from the beginning.

Cancer in situ

Cancer in situ (Locally malignant tumours): is a group of malignant tumour that spread only locally (invasive) with no distant spread (metastasis).

Depending on its location, in situ lesions usually can be removed surgically or treated so that the chances of recurrence are small.

For example:

In breast **Ductal Carcinoma In Situ (DCIS)** the cells have not crossed the basement membrane.

Cancer in situ of the cervix is essentially 100% curable.

The grading and staging of malignant tumours

The two basic methods for classifying tumour are:

1. Grading according to the histologic or cellular characteristics of the tumour.

2. Staging according to the clinical spread of the disease. It is useful in determining the choice of treatment for individual patients, estimating prognosis, and comparing the results of different treatment regimens.

Both methods are used to determine the course of the disease and aid in selecting an appropriate treatment or management plan.

The grading of tumours

The grading of tumours involves the microscopic examination of tumour cells to determine their level of differentiation. It is based on the **degree of differentiation.**

Accordingly, on a scale ranging from **grade I to IV.** **Grade I** neoplasms are **well differentiated** and **Grade IV** are **poorly differentiated** and **display marked anaplasia.**

Anaplasia is a change in the structure of cells and in their orientation to each other that is characterized by a loss of cell differentiation.

The staging of tumours

The staging of cancers uses radiographic examination (CT and MRI) and, in some cases, surgical exploration to determine **the size of the primary tumour, its extent of local growth, lymph node involvement, and presence of distant metastasis.**

The TNM staging system was developed by the Union Internationale Cancer Centre (UICC), and the American Joint Committee (AJC) system. In the **TNM** system:

T1, T2, T3, and T4 describe the increasing size of the primary tumour.

N0, N1, N2, and N3 advancing node involvement.

M0 or M1, describe the absence or presence of distant metastasis.