

Cancer Biology

Lecture No. 1

Presented by

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Course Structure

- Lecture No 1.** Characteristics of human cancer
- Lecture No 2.** Causes of cancer
- Lecture No 3.** The epidemiology of human cancer
- Lecture No 4.** The biochemistry and cell biology of cancer
- Lecture No 5.** Molecular genetics of cancer
- Lecture No 6.** Tumor immunology
- Lecture No 7.** Cancer diagnosis
- Lecture No 8.** Cequelae of cancer and its treatment
- Lecture No 9.** Cancer prevention

Lecture No 1.

Characteristics of human Cancer

Lecture's Structure:

- What is Cancer ?
- Description of Cancer
- Basic facts about cancer
- Hallmarks of malignant diseases
- Classification of Cancer
- Macroscopic and microscopic features of Cancer
- Tumour grading and staging

Characteristics of human Cancer

What is Cancer?

Cancer is an abnormal growth of cells caused by multiple changes in gene expression leading to dysregulated balance of cell proliferation and cell death and ultimately evolving into a population of cells that can invade tissues and metastasize to distant sites, causing significant morbidity and, if untreated, death of the host.

Characteristics of human Cancer

Description of Cancer

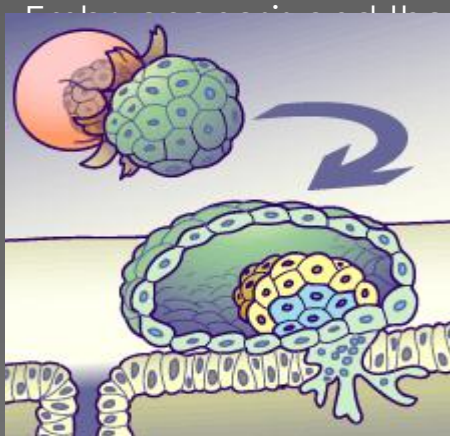
- 1- Group of diseases.
- 2- Abnormalities in gene expressions to favor the proliferation over the differentiation or apoptosis.
- 3- What differentiate benign tumour from malignant tumour is invasion (Metastasis).
- 4- Tumour heterogeneity (diff in metastatic potential, differentiation and proliferation rates and response to chemotherapy).

Characteristics of human Cancer

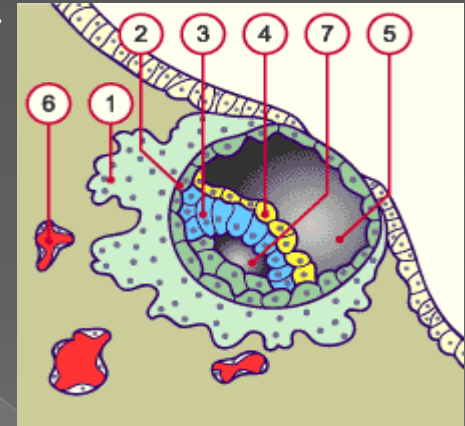
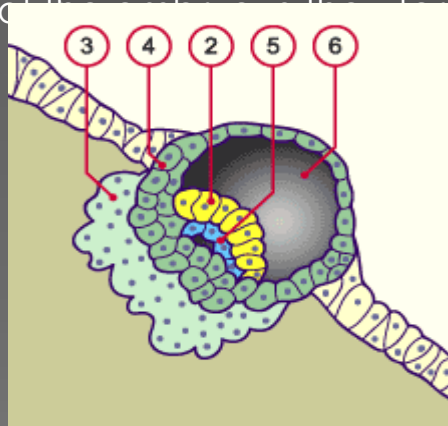
Description of Cancer

4- Cancer is a multiorganism disease.

Human vs Lower organisms



First characteristic is the invasion of the tumor cells into the tissue wall.



Migration of neurons to form neural crest for the development of CNS.

The huge genome of up to 40,000 genes which required perfect replication each cell division.

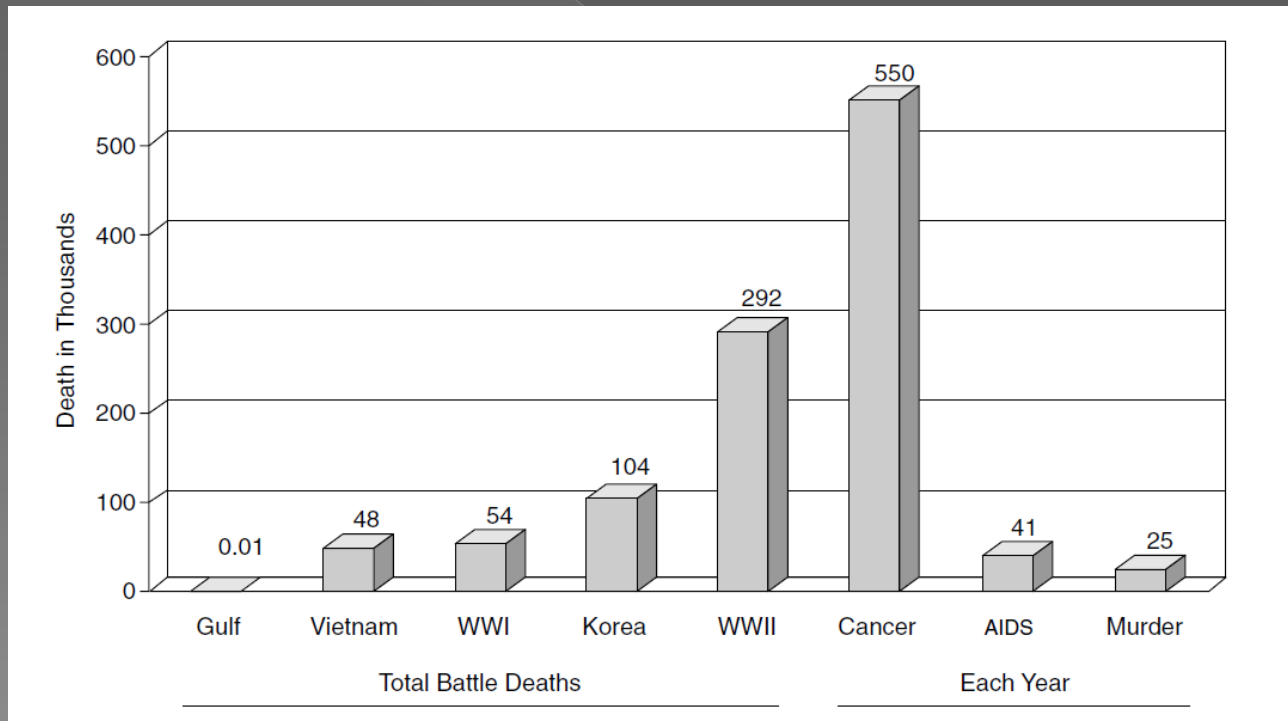
The huge number of cells which must replicate and differentiate perfectly every time.

The long lifespan which increases the chance of abnormality to occur.

Characteristics of human Cancer

Basic facts of Cancer

Cancer is a leading cause of death, Over 1.3 million new cases of cancer occur in the United States each year, not including basal cell and squamous cell skin cancers. The highest mortality rates are seen with lung, colorectal, breast, and prostate cancers.



Characteristics of human Cancer

Basic facts of Cancer

Cigarette smoking is a major causative factor.

These causal factors may act together to initiate (the initial genetic insult) and promote (stimulation of growth of initiated cells) carcinogenesis.

Latency: Often 10 to 20 years may pass before an initiated neoplastic cell grows into a clinically detectable tumor.

Disease of ageing. Although cancer can occur at any age, it is usually considered a disease of aging. The average age at the time of diagnosis for cancer of all sites is 67 years, and about 76% of all cancers are diagnosed at age 55 or older.

Characteristics of human Cancer

Basic facts of Cancer

Incidence rates of most cancer types has increased over time

- Lung Cancer: (Smoking)
- Longer life expectancy
- Lifestyle
- Pollution

Stomach cancer: Decreasing (Better food preservation).

Overall improvement of survival

In 1940s: 25% 5 years survival rates

In 1990s: 64% 5 years survival rates

Thus, 100,000 cancer patients would have been died if they live in 1940s.

Characteristics of human Cancer

Hallmarks of malignant disease

High proliferative rates: Neoplastic cells can develop in any tissue of the body that contains cells capable of cell division.

The high proliferative rates of neoplastic cells is not a unique characteristics (tissue renewal may be faster, intestine, bone marrow, hair follicles)

Characteristics of human Cancer

Hallmarks of malignant disease

Benign vs Malignant

1- Invasion

2- Metastasis

3- Anaplasticity (less differentiated)

Characteristics of human Cancer

Cancer Classification

- The suffix "Oma": (Lymphoma, melanoma, Thymoma)

Carcinoma

Epithelial tissues

Sarcoma

Mesenchymal in origin

Cancer Nomenclature.

Histologic type + **Carcinoma** + tissue type

Ex I: adenocarcinoma of the breast, squamous cell carcinoma of the lung, basal cell carcinoma of skin

Ex II: leiomyosarcoma of the uterus.

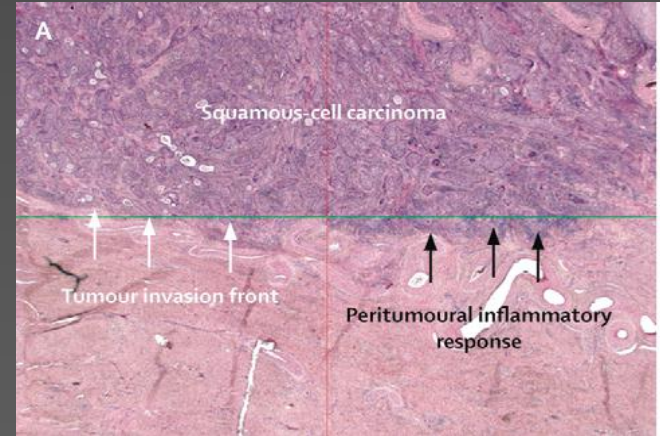
Characteristics of human Cancer

Cancer Classification

Squamous Epithelium



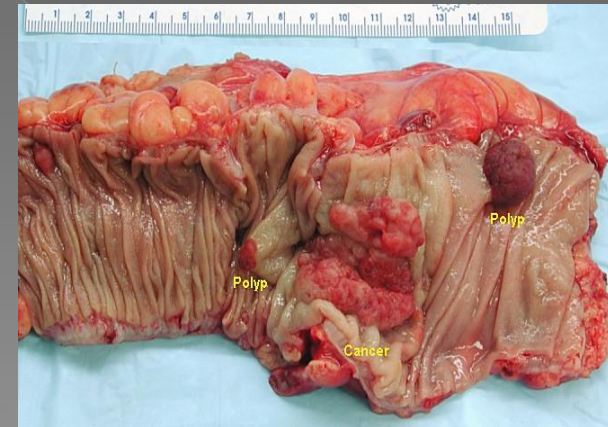
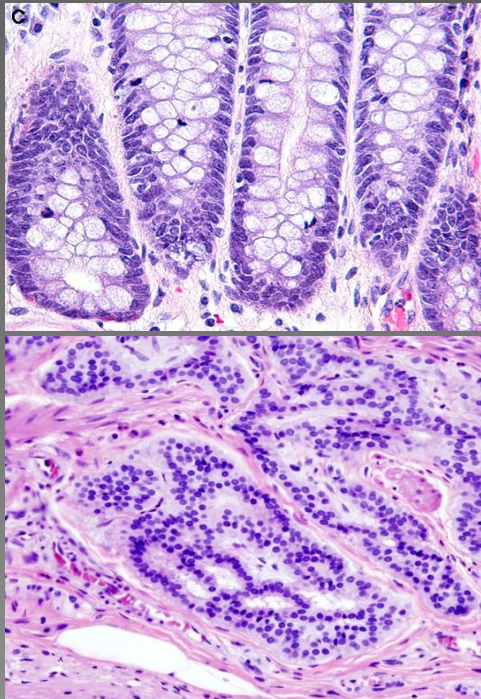
Squamous cell carcinoma
(Squamous Cell carcinoma of the lung)



Glandular Epithelium



adenocarcinoma
(Adenocarcinoma of the colon)



Characteristics of human Cancer

Cancer Terminology

Anaplastic: Undifferentiated

Metastasis:

(an adenocarcinoma of the colon metastatic to liver)

Mixed tumours:

- Mixed mesenchymal tumors of the uterus.

- Teratocarcinomas of the ovary (bone, cartilage, muscle, and glandular Epithelium).

Primary vs Secondary

Characteristics of human Cancer

Macroscopic features of neoplasms

Encapsulation.

Origin of the tumour: (likelihood and route of metastasis)

Effects on body functions:

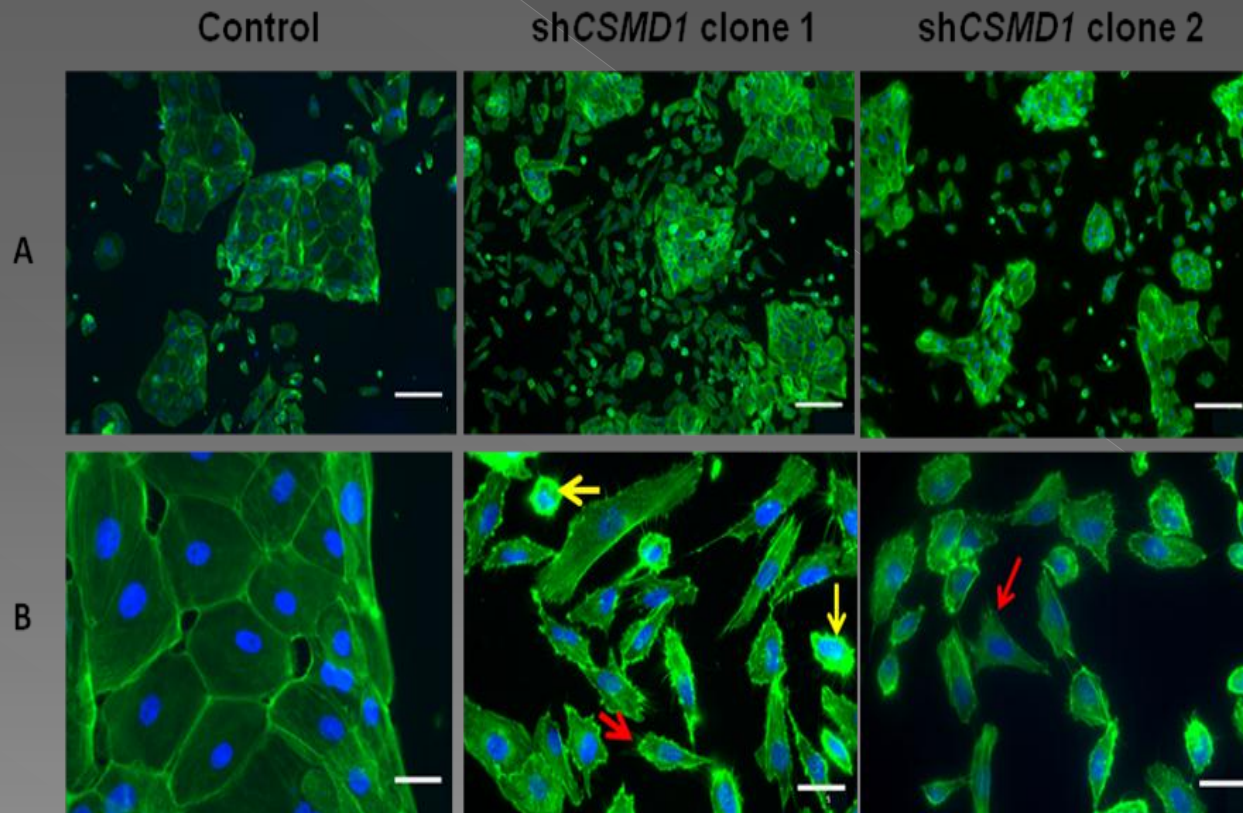
- A lymphoma growing in the mediastinum may press on major blood vessels to produce the superior vena caval syndrome, manifested by edema of the neck and face, distention of veins of the neck, chest, and upper extremities, headache, and dizziness.
- A small tumor growing in the brain can produce such dramatic central nervous system effects as localized weakness, sensory loss, aphasia, or epileptic-like seizures.
- A lung tumor growing close to a major bronchus will produce airway obstruction earlier than one growing in the periphery of the lung.
- A colon carcinoma may invade surrounding muscle layers of the colon and constrict the lumen, causing intestinal obstruction.
- One of the frequent symptoms of prostatic cancer is inability to urinate normally.

Characteristics of human Cancer

Microscopic examination of neoplasms

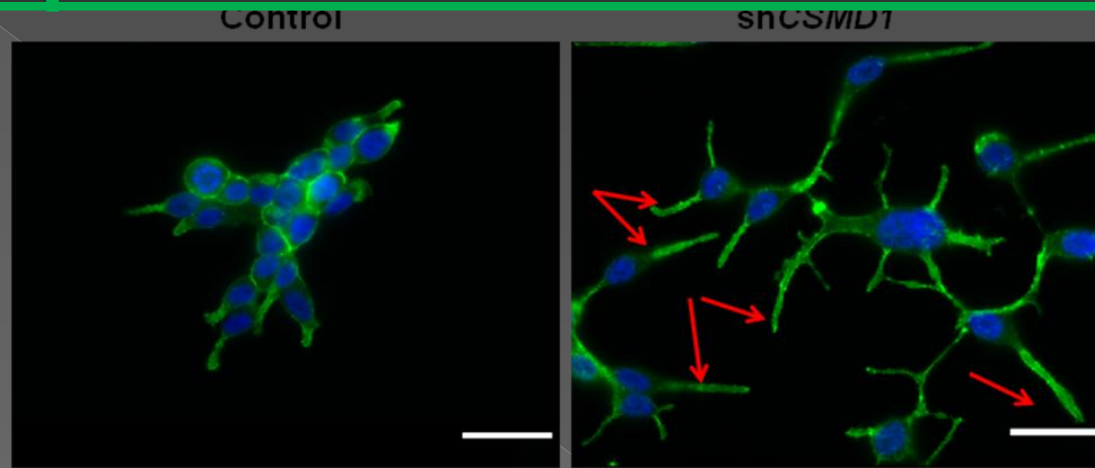
Confirm diagnosis

Morphology and size of cancer cells



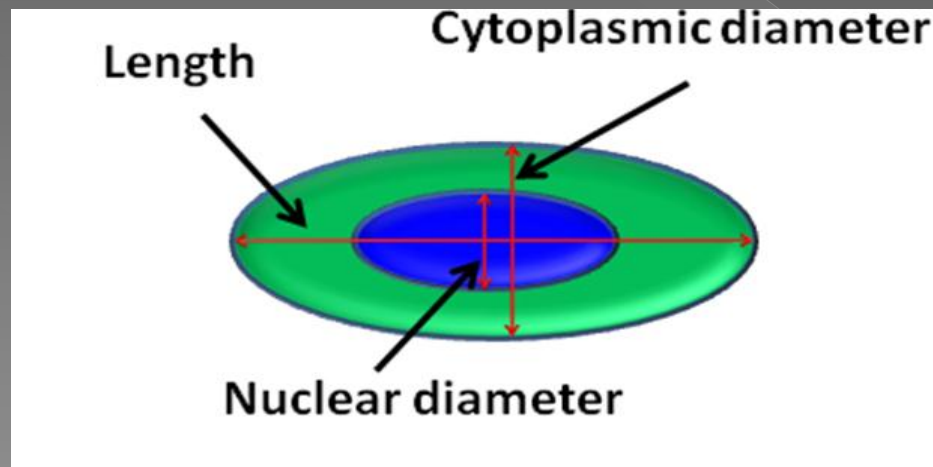
Characteristics of human Cancer

Microscopic examination of neoplasms



Cell Size

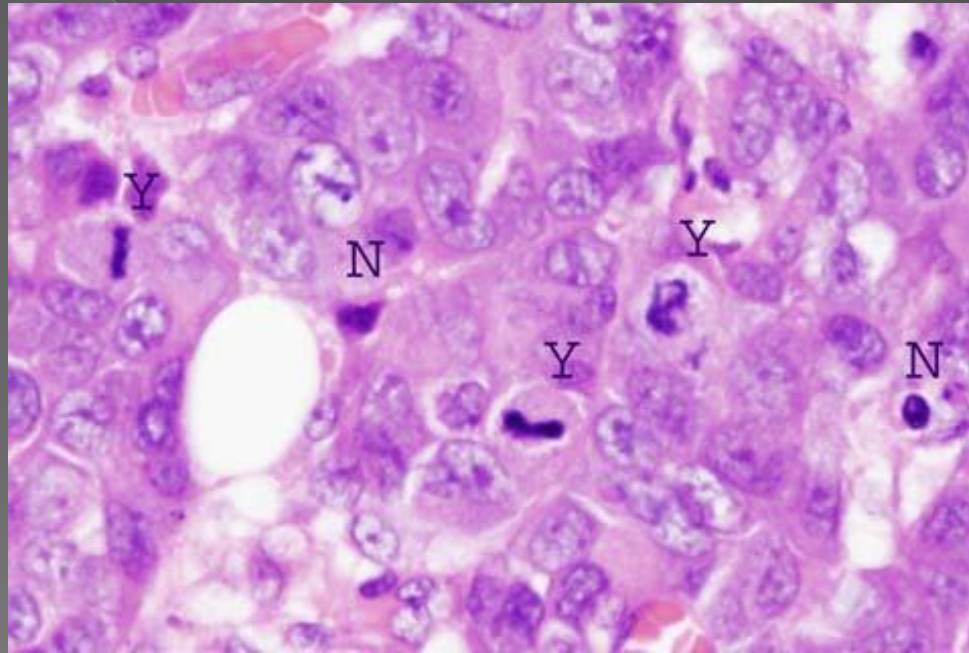
Large nuclei and higher nucleic to cytoplasmic ratio



Characteristics of human Cancer

Microscopic examination of neoplasms

Mitotic index (normal 1/1000, tumour up to 20/1000)



Larger nucleoli

Multinuclei cells

Obvious invasion (disruption of basement membranes)

Characteristics of human Cancer

Tumor grading and staging

For prognosis prediction (to reach the right treatment decision)

Tumour grading: (Cell differentiation and mitotic index)

Grade I: 75% : 100% Differentiation

Grade II: 50% : 75% diff

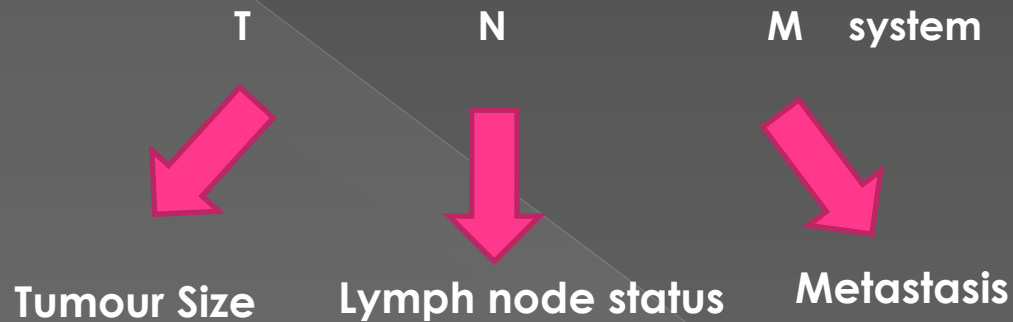
Grade III: 25% : 50% diff

Grade IV: 0% : 25% diff

Characteristics of human Cancer

Tumor grading and staging

Tumour Staging:



Stage I : (T1 N0 M0): survival is 70% to 90%.

Stage II : (T2 N1 M0): Survival is 45% to 55%.

Stage III : (T3 N2 M0): Survival is 15% to 25%.

Stage IV : (T4 N3 M+) : Survival is under 5%

Characteristics of human Cancer

Tumor Staging

Lymph node status:

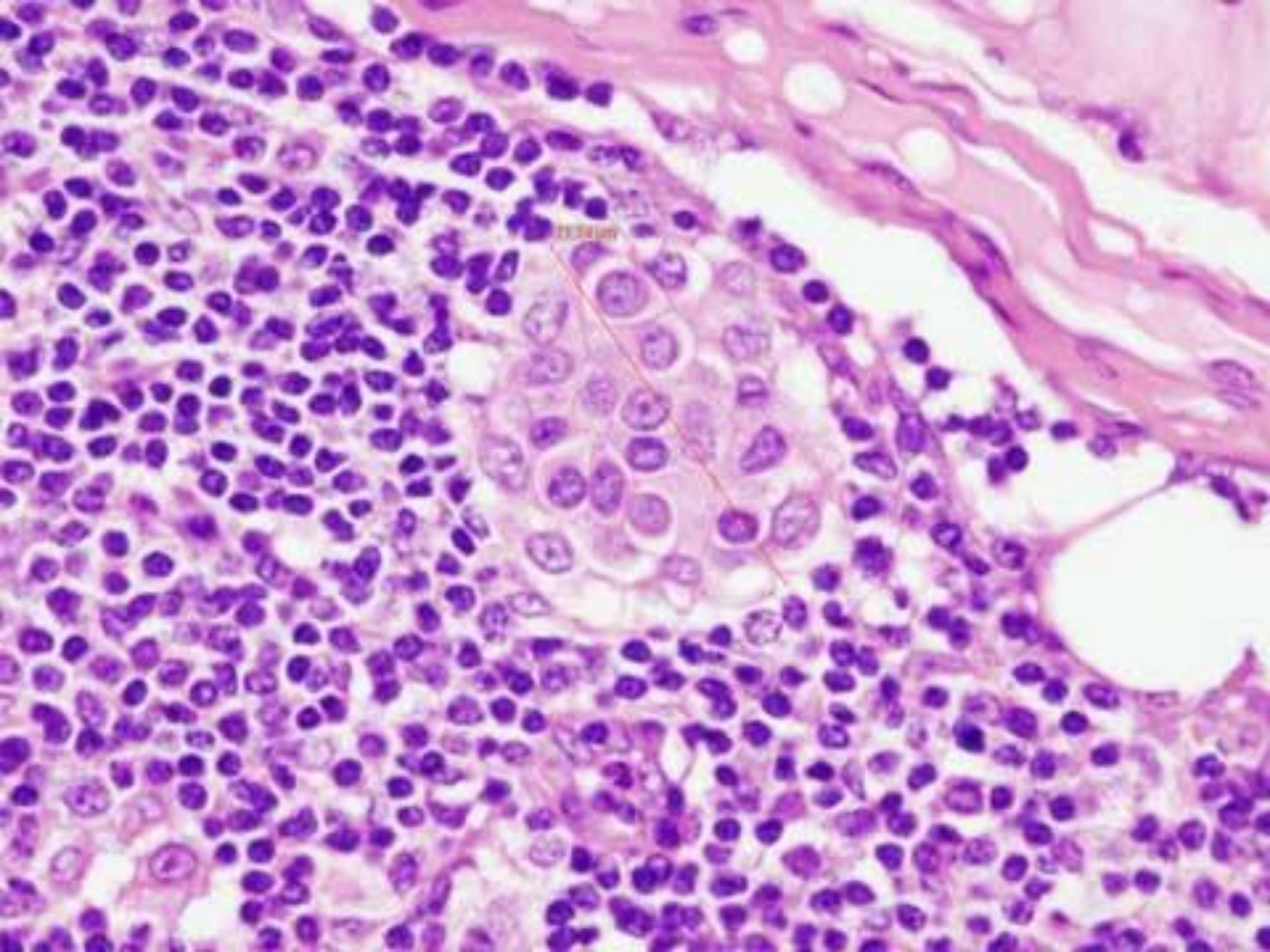
N0= No lymph nodes metastasis.

N1= Infected nodes but they are mobile.

N2= Larger infected nodes with partial mobility and invasion.

N3= Large with complete fixation.

N4= Extensive nodal involvement with invasion to distal sites.

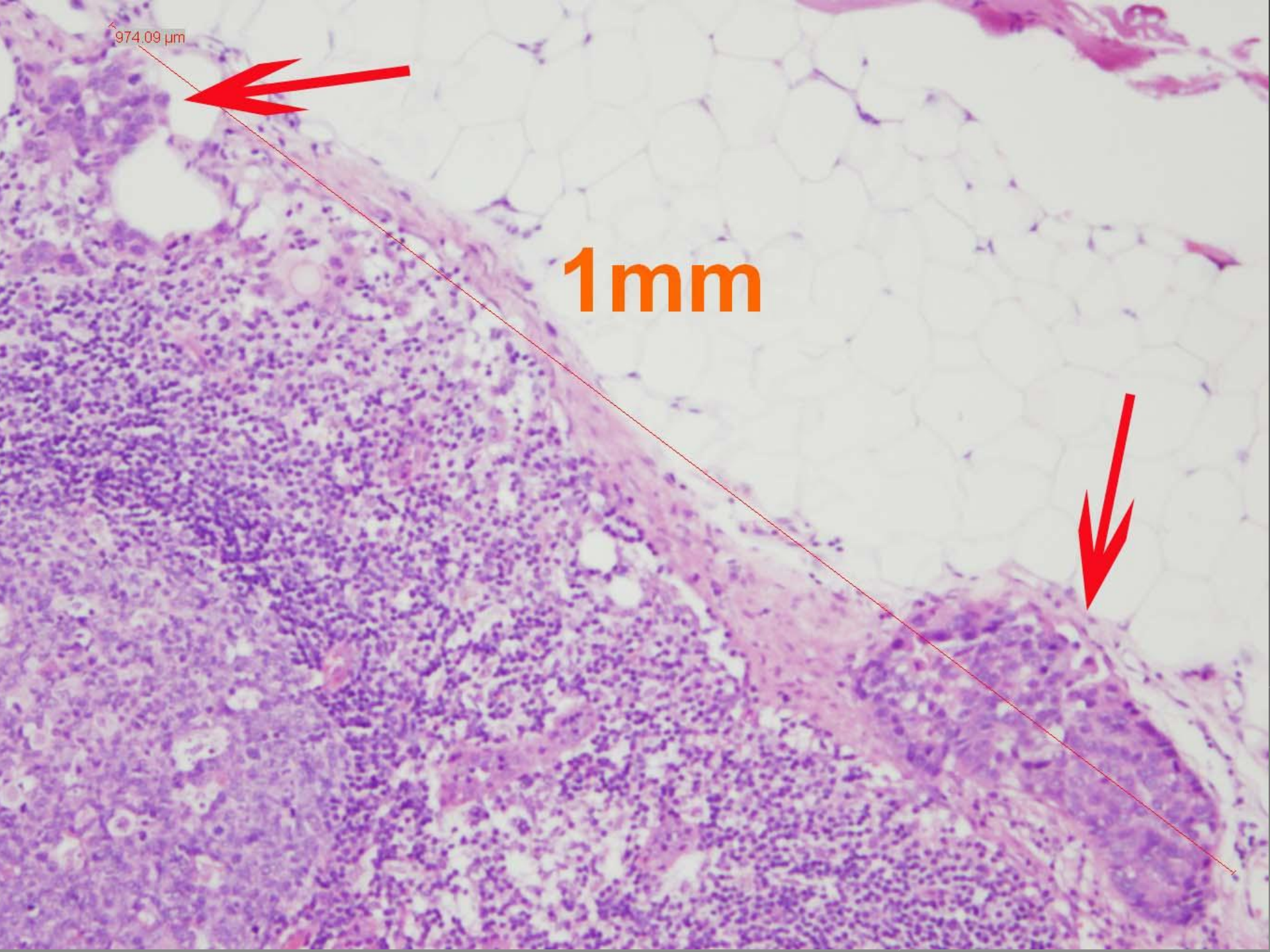


100µm

974.09 μm



1mm



Characteristics of human Cancer

Tumor Staging

Metastasis

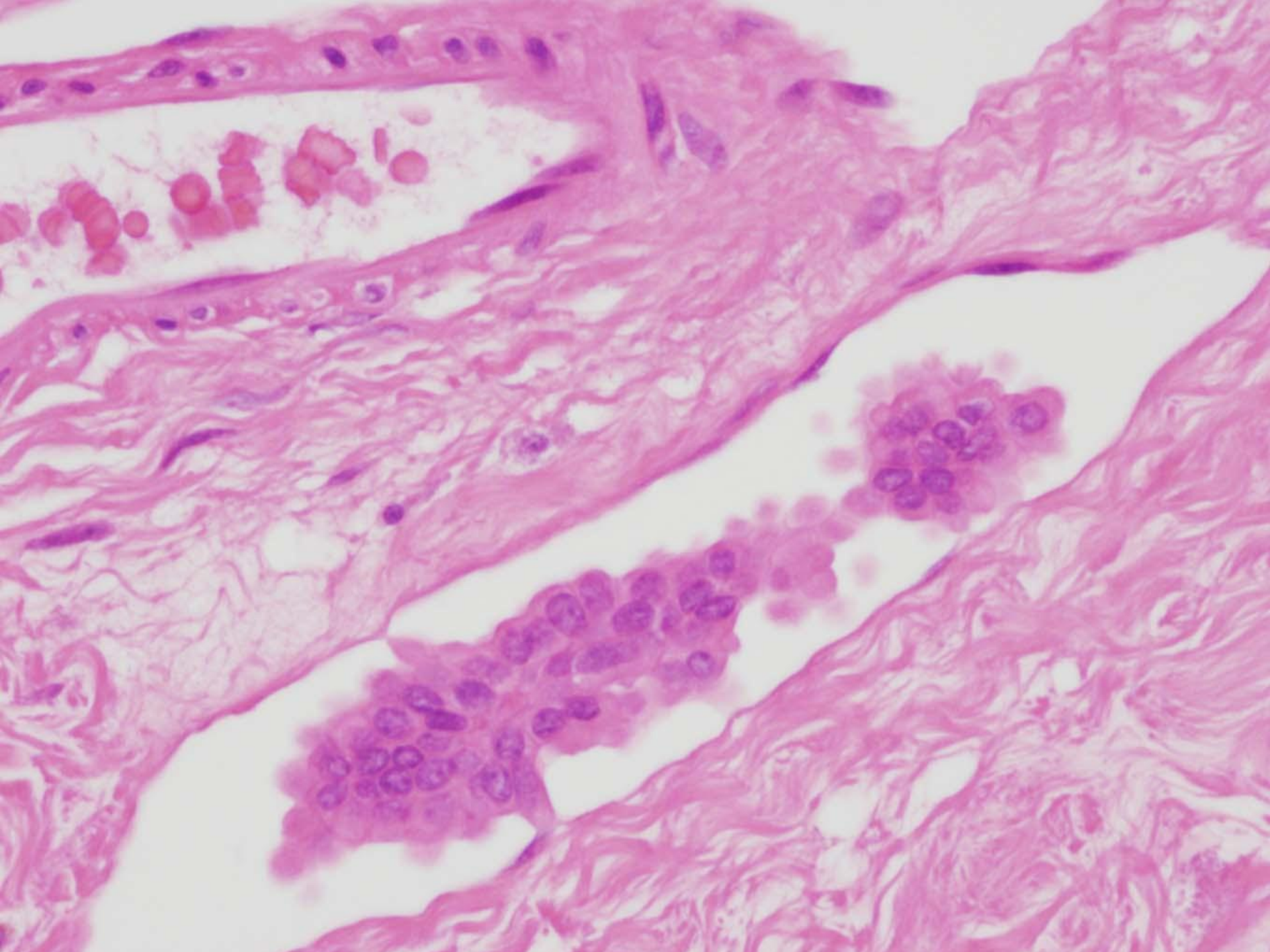
M0 = No signs of metastasis.

M1 = Isolated metastasis in one organ.

M2 = Multiple metastasis in one organ.

M3 = Multiple organs are involved but with no functional impairment.

M4 = Multiple organs involved with up to severe functional impairment.



Characteristics of human Cancer

Tumor grading and staging

Pitfalls of tumour grading and staging

They are not accurate: Tumour do not comply with the hypothetical linear progression.

The solution is the molecular biology of the tumours.

Questions