Tumors in animals

Neoplasm

- Oncology : onkos-bulk; logos-study
  - Branch of science which deals with neoplasm

- Neoplasm (Latin word) means -
  neo- new; plasm-mass of growth

- Neoplasia is an abnormality of cellular differentiation, maturation and control of growth.

Willis definition: Neoplasia

- “A neoplasm is an abnormal mass of tissue, the growth of which exceeds and is uncoordinated with that of the normal tissue and persists in the same manner after cessation of the stimuli which evoked the change” •
- “Cell division without control”
- Irreversible DNA damage, resulting in autonomous growth of abnormal cells *

Definition given by Mallory (1914)

"A neoplasm is a new growth of cells which–

1. Proliferate continuously without control
2. Bearing a considerable resemblance to the healthy cells from which they arise
3. Have no orderly structural arrangement
4. Serve no useful function
5. Have no clearly understood cause (Now a few causes of neoplasms have been identified)"

Characteristics

1. Proliferate continuously or intermittently and comparatively unlimited or uncontrolled and manifests varying degree of autonomy.

2. Bear a considerable resemblance to healthy cells from which they arise.

3. Have no orderly structural arrangement i.e. loss of tissue organization.

4. Serve no useful function.

5. In most of cases, no clear cause has been identified.

6. Continue to grow even after the cessation of the stimuli.

Gross changes: No definite shape, size, odour or consistency.

Shape - Variable

- Round
- Oval
- Elliptical/elongated
- Spherical
- Villus
- Polypoid
- Pedunculated - attached by narrow neck. They are usually benign.
- Sessile - relatively flat with a broad base. They may be suspected as malignant.

Size and weight: Variable

- Size : 1mm to several centimeters in diameter.
- Weight: 1mg to as much as 60 kg or even more

Colour:

Usually grayish white.

- Yellow (involvement of fat tissue)
- Red (due to haemorrhages/hyperemia)
- Brown (due to haemosiderin pigment)
- Black (due to melanin pigment)

Consistency:

- Hard or dense and firm – bone tumor, tumour of connective tissue containing considerable amount of collagen which makes tumour dense and firm.
- Soft and friable
- Watery – due to oedema
- Slimy – due to mucin

Histologically, all tumours have two basic components:

- Parenchyma – Proliferating neoplastic cells
- Supporting stroma – It consists of connective tissue, blood vessel and possibly lymphatics

Tumours are of two types:

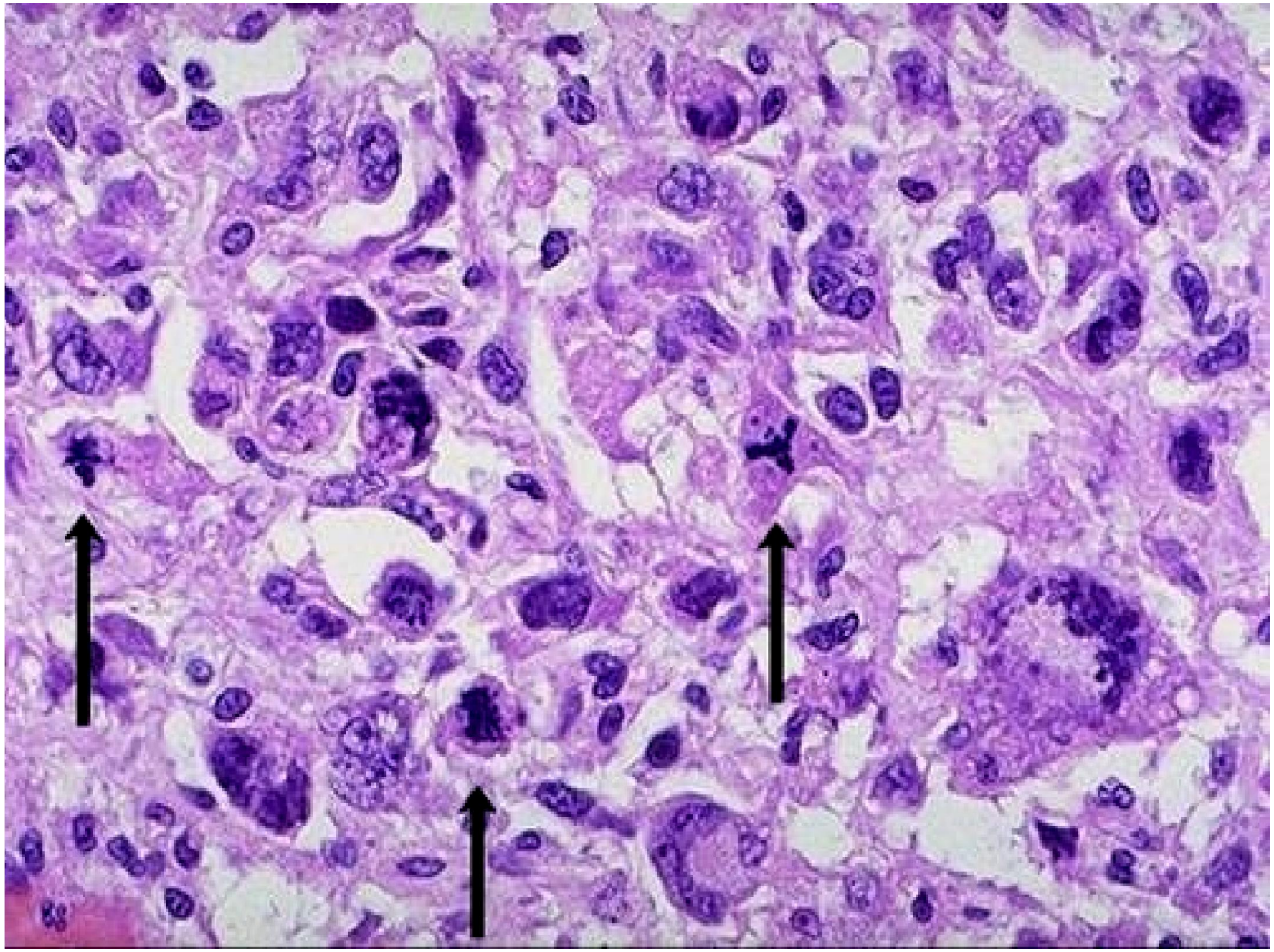
i) **Benign tumour** – Neoplastic cells closely resemble to the adult cell type Mature cells)

i) **Malignant tumour –** Cells resemble to embryonic cells type i.e. immature cells.

- So, there is reversion of adult cell (mature cell) to embryonic type due to lack of differentiation. This phenomenon is known as anaplasia

Features of anaplastic cells,

- i) Enlargement of nucleus.
- ii) Multiple nuclei in a cell (tumour giant cells).
- iii) Enlargement of nucleolus – apparently prominent.
- iv) Hyperchromasia of nuclei.
- v) Increase number of mitotic figures.
- vi) Nuclear.– cytoplasm ratio increased.
- vii) In malignant tumour, tumour cells may invade underlying tissue/basement membrane.
- viii) Presence of atypical or abnormal mitotic figures (abnormal cell division i.e. cell may divide into unequal number of daughter cells) also indicates malignancy.



CLASSIFICATION OF NEOPLASM

Tumours are classified based on-

- Histogenesis (Cell of origin) and
- Behavioral pattern (Dangerous to life or not).

1. Based on histogenesis, the neoplasms are classified as -

A. **Simple** tumours (Involvement of one cell type),

B. **Mixed** tumours (Involves more than one cell type arising from a single germinal layer) and

C. **Compound** tumours (Cells arising from all germinal layers).

2. Tumours are further classified based on behavioral pattern as -

A. **Benign** (not ordinarily fatal) and

B. **Malignant** (usually fatal).

S. No.	Histogenesis	Behaviour	
		Benign	Malignant
I.	**Simple tumours:** Epithelial cells Mesenchymal cells Others	-oma -oma -oma	-carcinoma -sarcoma -oma
I I.	**Mixed tumours**	Benign mixed tumour	Malignant mixed tumour
I I I.	**Compound** tumours	Mature teratoma	Immature teratoma

Nomenclature of Neoplasms

- The nomenclature of neoplasm has two components:-
- An **initial part (Prefix)** that indicates the type of cell (Histogenesis) and
- The **following part (Suffix)** indicates the benign or malignant nature of neoplasm.
- **All benign tumours** have the suffix –oma, while
- **Malignant tumours originating –**
  - From **epithelial cells** carry the suffix **carcinoma** and
  - Mesenchymal cells carry the suffix **sarcoma.**

Nomenclature of Neoplasms

- The suffix 'Oma' is used for benign tumour of surface epithelium and mesenchymal tumour except **Hematoma (accumulation of blood).**
- **Benign** tumours; of glandular epithelium are called as Adenoma **except tumour of hepatocyte (Hepatoma).**
- Similarly, **malignant** tumour of glandular epithelium is Adeno-carcinoma.
- For certain neoplasms, 'oma' is not used e.g. Mast cell tumour, Basal cell tumour.
- In certain malignant tumours, carcinoma/sarcoma is not used but the word malignant is substituted in the name i.e. Malignant melanoma, Malignant lymphoma.

Specific names of different neoplasms

Tissue of origin	Benign	Malignant
1. Adult Fibrous tissue	Fibroma	Fibrosarcoma
2. Embryonic Fibrous tissue	Myxoma	Myxosarcoma
3. Cartilage	Chondroma	Chondrosarcoma
4. Bone	Osteoma	Osteosarcoma
5. Fatty tissue	Lipoma	Liposarcoma
6. Histiocytes	Histiocytoma	Malignant histiocytoma
7. Mast cells	Mast cell tumour	Malignant mast cell tumour
8. Blood vessel	Haemangioma	Haemangiosarcoma

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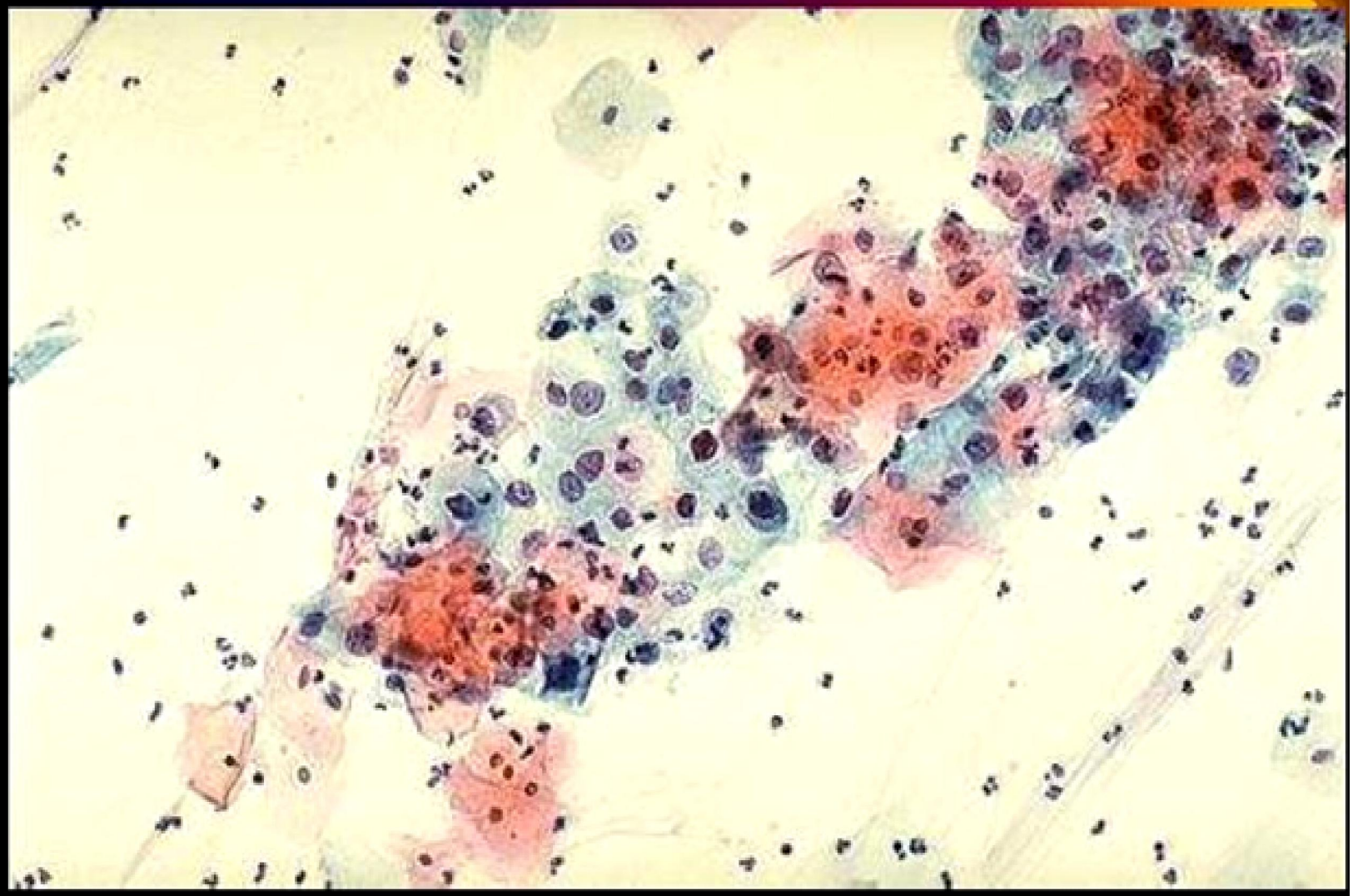
•9. Lymph vessel	Lymphangioma	Lymphangiosarcoma
•10. Smooth muscle	Leiomyoma	Leiomyosarcoma
•11. Striated muscle	Rhabdomyoma	Rhabdomyosarcoma
•12. Glial cells	Glioma	Glioblastoma
•13. Neuron	Not occur	Neuroblastoma
•14. Nerve sheath	Neurilemmma	Neurofibrosarcoma
•15. Melanocyte	Melanoma	Malignant Melanoma
•16. Squamous epithelial cells	Papilloma	Squamous cell carcinoma
•17. Glandular epithelium	Adenoma	Adenocarcinoma

cytology smear: adenocarcinoma

Pap smear with dysplasia



ETIOLOGY

Agents causing neoplasm (Oncogenic agents; Carcinogens)

Carcinogens are substances that are known to cause cancer or at least produce an increased incidence of cancer in animal and human

A. Predisposing causes	B. Definite causes
• Hereditary • Breed • Age • colour • Hormones	• Physical • Chemical • Biological

A.Predisposing causes

1. Hereditary

• Hereditary predisposition is observed for some tumours.

•The incidences of some neoplasms are proved to be high in some species as cell carcinoma of the eye in Hereford cattle and Lymphomatosis or Lymphoid leucosis in poultry

2. Age

• The malignant tumours usually occur in old age.

• Older age may be attributed to exposure to carcinogen and accumulation of somatic mutations.

• Moreover, the incidence of neoplasms increases with increasing age specially carcinoma.

• Sarcomas are more frequent in young age specially lymphosarcoma

• Congenital e.g. nephroblastoma or Wilms tumor often affects children ages 3 to 4. It becomes much less common after age 5 but may affect later also.

3. Colour (Pigmentation)

•Melanin pigment produced by melanocyte, protects skin against UV rays of sun. Hence, lack of pigmentation may lead to occurrence of tumours.

Eg. 1. Grey and white horses - malignant melanoma (especially old age)

2. Hereford cattle - ocular squamous cell carcinoma

4. Hormones

•Hormones like estrogen and progesterone may play a role to predispose animals to cancer.

• E.g. 1. Estrogen - Mammary tumour, ovarian carcinoma.

2. Progesterone - Mammary tumour in dogs and cats.

B. Definite causes

1. Physical

i) **Radiation** includes elctromagnetic radiation (UV rays, X rays and gamma radiation and particulate radiation (α, β, proton and neutrons) which are carcinogens.

2. Chemicals

•Sir Percival Pott in 1775 was the first scientist to identify chemical agent to cause of cancer.

• Carcinogenesis is a multistep process involving a sequence of initiation (mutation) followed by promotion (proliferation)

Initiators -The chemical carcinogen fall into two categories-

1. Direct acting carcinogens
2. Indirect acting carcinogens

B. Definite causes

1. Direct acting

It acts locally at the site of application without having to undergo metabolic change in the body. These are mutagens that cause cancer directly by modifying DNA.

- Eg. Alkylating agents - β propiolactone, Dimethylsulfoxide
- Aceylating agents - 1 acetyl imidasone

2. Indirect acting carcinogens or procarcinogen

- This group contains most chemical carcinogens. These chemicals as it self not producing cancer but need to be metabolized in liver firstly to produce highly carcinogenic substance. These require metabolic conversion to form active carcinogens.
- Eg. **Polycyclic and heterocyclic hydrocarbons** - Benzanthracene
- **Nitrosoamines and nitrosoamides** - Vinyl chloride, aldrin, dieldrin

B. Definite causes

2. Indirect acting carcinogens or procarcinogen cont……

•Aflatoxin B1 - Hepatocellular carcinoma in poultry

Promotors -

• Cause cellular proliferation of mutated (initiated) cells

• Proliferation of a mutated cell may lead to accumulation of additional mutations

Clinically important chemical carcinogens –

•Cigarette smoke: multiple malignancies

•Asbestos: bronchogenic carcinoma, mesothelioma

•Arsenic: squamous cell carcinomas of skin and lung, angiosarcoma of liver

•Alkalating agents: leukemia, lymphoma, other cancers

•In nut shell – Life style

B. Definite causes

3. Biological causes-

Bacteria: *Helicobacter pylori* – gastric cancer and lymphoma in man

Parasites

Spirocera lupi - Oesophageal fibrosarcoma and osteosarcoma in dogs

Schistosoma haematobium – bladder cancer in man

Viruses –

Naturally occurring tumors of animals are caused by RNA and DNA viruses

DNA viruses –

Oncogenic DNA viruses include herpesviruses, papovavirus and hepatitis B viruses of man.

Canine oral papilloma, bovine papilloma, human papilloma

Pox viruses – fibroma, myxoma in rabbit

Herpes virus – Marek's disease chicken

Oncogenic RNA viruses –

RNA viruses that cause neoplasms are members of retroviridae

Retroviruses – Lymphoid leucosis

Rous sarcoma virus – Tumours in poultry

The differences between benign and malignant neoplasms

Features	Benign	Malignant
Gross Picture		
Growth rate	Slow	Rapid
Shape	Rounded with stalk	diffuse without stalk
Type of growth	By expansion	By invasion
The progress of growth	Limited	Unlimited
Capsule	Capsulated	Uncapsulated
Method of Spread	Not spread	Spread by metastasis
Size	Usually small	Usually large
Microscopic Picture		
Differentiation	Well-differentiated	Undifferentiated with variable degree (Anaplasia)
Stroma	Well formed	Poorly formed / Scanty
Hemorrhage	Little or no hemorrhage	Hemorrhage usually occur
Necrosis	Little necrosis	Necrosis
Mitosis	Few mitosis	Numerous mitosis
basement membrane	Intact	Broken
Blood vessel	Well developed	Ill developed
Cellularity	Less cellular	Highly cellular
Nucleus	Normal	Enlarged
Hyperchromasia	Absent	Hyperchromatic
Pleomorphism	Absent	Present
Recurrence & Prognosis		