VETERINARY ONCOLOGY

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GENERAL ONCOLOGY

TUMOR

- A swelling of a part of the body
- CELSUS / rubor – kalor – tumor – dolor – funcsio lacea

WHO IS CELSUS?

- Aulus Cornelius Celsus (c. 25 BC – c. 50 AD) was a Roman encyclopaedist, known for his extant medical work, De Medicina, which is believed to be the only surviving section of a much larger encyclopedia.
- His work contains detailed descriptions of the symptoms and different varieties of fever, and he is credited with recording the cardinal signs of inflammation known as "Celsus tetrad": calor (warmth), dolor (pain), tumor (swelling) and rubor (redness and hyperaemia)

TUMOR

- Today, the term “tumor” is *used* as a synonym for a *neoplasm*
- *Neoplasia* - Terminology *neo* =new, *plasia* = growth
- The branch of science dealing with the study of neoplasm or tumor is called *oncology* (*oncos* = tumor, *logos* = study)

TUMOR

- "A neoplasm is an abnormal mass of tissue, the growth of which *exceeds* and is *uncoordinated* with that of the normal tissues, and persists in the same excessive manner after cessation of the stimulus which evoked the change." *R.A. Willis*

Classification of neoplasms

- Etiological
- Anatomical features
- Embryological
- Functional
- Classification according to morphological characteristics

- Classification according to the *histogenetic* or *cytogenetic* origin

  1) Epithelial 2) Mesenchymal

- Classification according to *biological behavior*

  1) Benign *2) Malignant*

Classification of neoplasms

- **Histogenetic (cytogenetic) classification**,
- It is a classification according to the *tissue type* from which the tumors *originate*.
  Accordingly, tumors are divided into two main groups, **epithelial** and **mesenchymal**.

- This classification is practical.
  Because cell type is one of the most important things and invariant features of the tumor.

Classification of neoplasms

- **Classification according to biological behavior** (TUMOR CHARACTERISTICS)

Divided into
benign and **malignant**

Classification of neoplasms

- **Classification according to biological behavior** (TUMOR CHARACTERISTICS)

BENIGN TUMORS ;

- similiar to tissue cells they originated from (well-differentiated appearance)
- localized
- growing slowly and expansively
- encapsulated
- have basal membrane (intact)
- have low mitotic index
- not make metastase and invasion

Classification of neoplasms

- **Classification according to biological behavior** (TUMOR CHARACTERISTICS)

MALIGNANT TUMORS

- Not similiar to tissue cells they originated from (lack of differentiation)
- have the ability to make invasion and metastase to surrounding tissues and veins
- growing rapidly and infiltrating
- mitotic index is high

Nomenclature of tumors

- **For mesenchymal tumors:**

  1) Benign: The suffix "-oma" is added to the name of the tissue e.g. *fibroma, osteoma, chondroma*.

  2) Malignant: The suffix "-sarcoma" is added to the name of the tissue e.g. *fibrosarcoma, osteosarcoma, chondrosarcoma*.

- **For epithelial tumors:**

  1) Benign: The suffix "-oma" is added to the name of the tissue e.g. *adenoma, papilloma*.

  2) Malignant: The suffix "-carcinoma" is added to the name of the tissue e.g. *adenocarcinoma, squamous cell carcinoma, basal cell carcinoma*.

Nomenclature of tumors

- **Mixed tumors**: Some tumors formed by *different types of tissues* which have resulted due to *metaplasia* of the orriginal tissue, e.g. The mammary gland tumor may be formed of cartilage, bone, fibrous tissue and glandular tissue.

Cassali et al, 2017
DOI: 10.24070/bjvp.1983-0246.v10i3p87-99

Nomenclature of tumors

- **Teratoma:** These are neoplasms of multiple tissues of different kinds, foreign to the area in which they arise and may be benign or malignant.
- These tumors are commonly associated with **gonads** and contain hair, nerveous tissue, glandular or epithelial lining of bronchi or intestinum. The tissues are from *ectoderm, endoderm and mesoderm.*

www.deviantart.com

http://www.pathologyoutlines.com/topic/ovarytumorteratomamature.html

Nomenclature of tumors

- In tissues and organs tumors can develop *solitary* or *multiple*.
- If a tumor is more than one in the organism,

the suffix "-atosis" is added to the tumor name.

e.g. *papillomatosis*, *adenomatosis*, *fibromatosis*

Nomenclature of tumors

- The basic structure of all tumors is made up of two elements:

  1) Proliferating, neoplastic cells which comprise the **parenchyma** of the tumor

  2) Supportive **stroma** made up of connective tissue and blood vessels.
- If these two structures are intertwined with each other in the tumor, it is called “histioid tumor”
- If the stroma and parenchyma are separate, such tumors are called "organoid tumors".

General Characteristics of Tumors

- Tumor is abnormal tissue growth. It is a new cell type that differs in some characteristics and this change is irreversible.
- Grow as unlimited.
- Tumor cells proliferate faster, are not beneficial to the organism, and not need to be stimulated.
- Tumor cell shows autonomy.

General Characteristics of Benign and Malignant Tumors

Benign and malignant tumors are distinguished by their morphological findings.

- Cell morphology
- Cell arrangement and organization
- Mitosis
- Giant cells
- Stroma
- Vascularization
- Growth rate
- Developmental pattern
- Metastasis
- Recurrence
- Structure and shape properties

General Characteristics of Benign and Malignant Tumors

Cell morphology:

- Neoplastic cells often show considerable morphologic variability compared with the normal tissue from which they are derived.
- The benign tumor cell is very similar to the cell from which it originated; this is called a typical cell.
- A malignant tumor cell is not similar to the cell from which it originates; this is called the atypical cell.

General Characteristics of Benign and Malignant Tumors

Cell morphology:

- Each normal, fully differentiated, mature tissue type has a characteristic gross and microscopic appearance that varies between species.
- Neoplastic tissues lose these differentiated features of cellular morphology and organization to a variable extent.
- In general, malignant tumors appear less differentiated than benign tumors (atypical cells).
- Benign tumors are well-differentiated (typical cells).

General Characteristics of Benign and Malignant Tumors

- **Anaplasia** is a condition of cells with poor cellular differentiation, losing the morphological characteristics of mature cells.
- The term also refers to a group of morphological changes in a cell that point to a possible malignant transformation.
- This type of tumor is called as undifferentiated or anaplastic tumor.

Characteristics of Atypical (Anaplastic) Cells

- **Pleomorphism**
  - *Anisocytosis
  - *Anisonucleosis
- **Hyperchromasia**
- **Polychromasia**
- **Giant nucleus** (Tumor type giant cell)
- **Mitosis**

General Characteristics of Benign and Malignant Tumors

Growth rate:

- Benign tumors develop slowly. Sometimes it takes months to be noticed.
- Growth is faster in malignant tumors. However, this rate varies from tumor to tumor, the more malignant is one that has faster development.

General Characteristics of Benign and Malignant Tumors

Developmental pattern:

- Benign tumors, when growing, push the tissues of their surroundings and make place for themselves. Such development is called "expansile development".
- Benign tumors usually have a fibrous capsule that separates the tumor from the surrounding tissues. However, there is no rule that all benign tumors should be encapsulated.

General Characteristics of Benign and Malignant Tumors

Developmental pattern:

- "Infiltrative development" is one of the most important features of malignant tumors.
- Infiltrative is a term used for referring to that "which infiltrates or spreads".

- Malignant tumor cells are not encapsulated in their surroundings, they infiltrate into adjacent tissues and cells, either singly or in groups.

General Characteristics of Benign and Malignant Tumors

Developmental pattern:

- Non-neoplastic epithelial cells generally rest on a specialized extracellular structure called the *basement membrane, to which they are* firmly attached by hemidesmosomes.
- In benign epithelial tumors, the basement membrane usually remains intact, whereas in malignant tumors the neoplastic epithelial cells penetrate the basement membrane to invade surrounding tissue. This is called "invasion".

INVASION

- There are three basic stages of malignant tumor cell invasion to the normal tissue.

1. adhesion of tumor cells
2. enzymatic degradation of local tissue barriers
3. movement of tumor cells

General Characteristics of Benign and Malignant Tumors

Metastasis:

- The spread of tumor cells and establishment of secondary areas of growth is called *metastasis*; most malignant cells eventually acquire the ability to metastasize. Thus the major characteristics that differentiate malignant tumors from benign ones are their invasiveness and spread.

General Characteristics of Benign and Malignant Tumors

Recurrence:

- After the removal of the tumors by operation, *Recurrence* is a formation of new tumor in the same location and with the same characteristics as the the original (primary) *tumor*.

Features of Malignant Tumor Spread

- Local
- Metastasis

Features of Malignant Tumor Spread

Local Spread:

- It is the extend of primer tumor into the organ where it developed or adjacent tissues

Metastatic Spread:

- *Metastasis* is a pathogenic agent's (now it is malignant tumor cells) spread from an initial or primary site to a different or secondary site within the host's body

Metastasis

- The characteristic of malignant tumors
- All tumors that metastasize are malignant
- However, there is no rule that every malignant tumor must metastasize.
- Anaplasic and large tumors are more likely to metastasize.
- Factors such as stress, surgical interventions, anesthetic materials, and some treatments may increase the risk of metastasis.

Metastasis

In order for tumors to metastasize, tumor cells must successfully complete multiple steps. These steps can be summarized as follows:

1. The cell or cells must be able to must detach (=separate) from the main tumor mass.
2. Must be able to invade the local tissue (penetrate the basement membrane, and enter the ExtraCellularMatrix-ECM)
3. Entry into blood vascular or lymphatic vessels to create an embolism.
4. Embolic tumor cells should survive in circulation.
5. Embolic tumor cells should make adhesion to basement membrane of vessel and extravasation
6. Must defend host defense in new site.
7. It should multiply and vascularize by local invasion

Metastasis

- Lymphogenic metastasis
  (Retrograde lymphoid metastasis)
- Hematogenous metastasis
- Implantation metastasis
- Contact metastasis
- Ductal metastasis

Etiology of tumors

- **Intrinsic factors (Predisposition)**
- Extrinsic factors

Etiology of tumors

- **Predisposition:**
  - Age
  - Breed
  - Sex
  - Organ
  - Inheritance

Etiology of tumors

- **Age:** Tumors occur in all ages, but usually in the elderly. While it is unknown why tumors are more common in older ages, the following points are emphasized:
  - Tumors need a latent period for development. With the advance of age, the tumors that have the longest latency period can have a chance to appear.
  - Long-lived organisms are more exposed to cancer-causing agents.
  - Older tissues may become more susceptible to cancer formation.
  - Hormonal imbalances occur at advanced ages.
  - At advanced ages, the immunity system may weaken and tumor formation may become easier.

In cats and dogs:
6-14 years old

In horse and cattles:
5-14 years old

Etiology of tumors

- **Breed**
- Squamous cell carcinomas are very common in Hereford cattle because of lack of **pigment** around their **eyes.**
- Osteosarcomas are more common in large breed dogs (St. Bernard and Great Dane)
- Mammary cancers in dogs and cats,
- Penis cancers in horses,
- Mast cell tumor in boxer dogs are seen.

Etiology of tumors

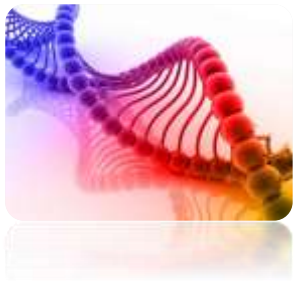
- **Sex**
- Female **dogs** have more tumors than males (bacause of the large number of mammary tumors)
- In male **cats**, more tumors are formed than in females

  (because the large number of lymphoma in male cats)

Etiology of tumors

- **Organ:**
- Human
  ♂ lung, skin and prostate cancers
  ♀ mammary cancers are more common.
- Dog
  Basal cell carcinoma
  Sweat gland cancer (skin)
  Mast cell tumor (skin of hind limbs)
  Bowel cancer (jejunum-rectum)
- Cat
  Lymphoma (intestine or mediastinal lymph node)
- Horse
  Papilloma (around the lips and nose)
  Melanoma (periphery of the anus)

Etiology of tumors



- **Inheritance:**

Some individuals are more prone to cancer than others.

In humans, familial predispositions have been identified in terms of ovarian, mammary gland, colon, prostate tumors and malignant melanomas.

Etiology of tumors

- Intrinsic factors
- **Extrinsic factors**

Etiology of tumors

Extrinsic factors: The factors that cause cancer in humans and animals are called *carcinogens* or *oncogenes*.

- **Physical causes**
  a) Chronic irritations and trauma
  b) Ultraviolet rays
  c) X-rays
  d) Heat
- **Chemical causes**
  a) Polycyclic aromatic hydrocarbons
  b) Aromatic amines
  c) Azo pigments
  d) Other chemical substances
- **Oncogenic (cancer-causing) viruses**
- **Parasites**
- **Hormones**

Etiology of tumors

- **Physical causes**

  Chronic irritations and trauma: These are mechanical effects such as pressure and friction. Respectively; tissue loss, chronic inflammation, regeneration, and neoplastic devolopment are formed.

  - Nasal rings lead to fibroma in bulls
  - Ear tags leads to papillomas in cattles
  - Stomach ulcers may turn into carcinoma over time
  - Osteosarcomas can be formed in fractures of long bones

Etiology of tumors

❖Physical causes

Ultraviolet rays:

- In seamans and farmers working for long periods in the field, hyperkeratosis and hyperpigmentation especially in the hands and on the faces, are firstly formed. Over time, skin cancers can develop.
- Ultraviolet rays with a spectrum of 2800-3200 A^{o} have a carcinogenic effect.
- Skin cancers are more common in animals with light-skinned (have less pigment).

Etiology of tumors

- **Physical causes**

  X-rays:

- Due to the lack of good protection of workers with x-rays, especially in the hands, firstly radiodermatitis and later skin cancers were seen as an occupational disease. Likewise, it has been observed that the incidence of leukemia is high among radiologists.
- Today, by taking the necessary precautions and using more advanced x-ray devices, the carcinogenic effect of x-rays has been reduced or eleminated.

Etiology of tumors

❖Physical causes

Heat:

- Squamous-cell carcinoma of the skin occurs on the lower abdomen and inner thighs and is due to the use of a **kangri**, a baked clay pot weaved around with wicker-work, used as a source for warmth by people in Kashmir during cold weather (Kashmir/Indian, 1881) **(Kangri cancer).**

Etiology of tumors

Heat:

- It is believed that the lower lip carcinoma in the pipe drinkers is formed by the warm effect of the pipe.
- Native Venezuelans smoke cigarettes by putting the burning side into the mouth to breathe much more smoke. In these people, palate cancer has been detected more frequently. It is suggested here that the role of tar is also effective.

Etiology of tumors

- **Chemical causes**

More than 700 chemical substances are known to be carcinogenic.

The idea that chemicals can make cancer was first proposed by British surgeon Percival Pott in 1775.

Pott suggested that scrotum cancers were common among chimney sweepers (6-10 years of age) because of exposure to coal or heat.

140 years after this observation, scientists started new research about cancer caused by tar.
In 1915, Yamagiwa and Ishikawa successfully induced **squamous cell carcinoma** by painting crude **coal tar** on the inner surface of rabbits' ears.

Etiology of tumors

- **Chemical causes**

a) Polycyclic aromatic hydrocarbons: They are strong carcinogenic chemical substances obtained from coal tar.
b) Aromatic amines: They are organic compounds consisting of an aromatic ring attached to an amine.
c) Azo pigments: Azo pigments are important in a variety of plastics, rubbers, and paints (including artist's paints).
d) Other chemical substances

Etiology of tumors

❖ **Oncogenic viruses**

Virus	Genus	Tumor
	DNA Virus	
Adenovirus	Hamster	Various experimental tumors
Herpesvirus		
Marek virus	**Chicken**	**Lymphosarcoma**
Rabbit herpesvirus	Rabbit	Lymphosarcoma
Guinea pig herpesvirus	Guinea pig	Lymphosarcoma
Herpesvirus Saimiri	Primates	Lymphosarcoma
Epstein-Barr virus	Human	Burkitt lymphoma
		Nasopharyngeal carcinoma
Lucke virusu	Frog	Renal adenocarcinoma
Papovaviruses		
Simian Virus 40 (SV40)	Hamster	Experimental sarcomas
Polyoma virus	Mouse	Numerous experimental tumors
Papillomavirus	**Cattle, Dog, Rabbit, Human**	**Papilloma**
Poxvirus		
Yaba virus	Rhesus monkey	Histiocytoma
Shope fibroma virus	Rabbit	Fibroma, Mixomatosis
	RNA Virus	
Retroviruslar	Chicken	Lymphosarcoma, Sarcomas (Leukosis coplex and Reticuloendothelosis)
	Cat	**Fibrosarcoma, Lymphosarcoma, Leukemia**
	Mouse	Lymphosarcoma, Leukemia, Mammary tumors
	reptiles	Sarcomas
	Cattle	Lymphosarcoma
	Sheep	**Pulmonary adenomatosis**
	Human	T-cell tumors

Etiology of tumors

❖ Parasites

- Gangylonema neoplasticum - Rat - Stomach - Papillomas and carcinomas
- Cysticercus fasciolaris - Rat - Liver - Sarcoma
- Eimeria stidae - Rabbit - Bile ducts - Papillary adenom
- Cnemidocoptes mutans - Chicken - Leg skin - Carcinoma
- Spirocerca lupi - Dog - Esophagus - Fibrosarcoma
- Gastrophilus horses - Horse - Stomach - Papillomas and carcinomas
- Clonorchis sinensis - Cat / Dog - Biliary tract - Cancer
- Schistosoma hematobium - Human – Urinary bladder- Cancer
- Schistosoma japonicum - Human - Rectum - Cancer

Etiology of tumors

- **Hormones**
- Mammary cancer has been formed in mice given estrogen for a long time. Likewise, mammary cancer also occur in women with estrogen hormone .
- Women who use diethylstilbestrol (DES) during their pregnancy can develop vaginal cancer when their daughters are 15-20 years old.
- It is known that the hormonal state is effective in the development of canine mammary tumors.

The clinico-pathological effects of tumors

- Local Effects
- Systemic Effects
  - Cachexia
  - Hypoglycemia
  - Anemia
  - Clotting disorders
  - Hyperglycemia
  - Ectopic hormone syndromes
  - Diarrhea
  - Fever
- Neuropathic Effects

Treatment of tumors

- Surgical treatment

  Curative - Preventive - Diagnostic - Palliative

- Radiotherapy
- Chemotherapy
- Hormone therapy
- Immunotherapy