THE SCIENCE WORLD
A Monthly e Magazine
ISSN:2583-2212
February, 2023; 3(02), 143-146

Popular Article

Radiation Therapy in Veterinary Oncology

Amitha Banu S*, Sharun Khan, A M Pawde
Division of Surgery, ICAR-Indian Veterinary Research Institute, Izatnagar, Bareilly, Uttar Pradesh, India
https://doi.org/10.5281/zenodo.7633562

Abstract

Radiation therapy (RT) is an important therapeutic tool for treating various veterinary ailments. The utmost application of RT in veterinary medicine is for managing tumors. A large population of animals is benefited from the application of RT for cancer. RT paved the way for the effective management of previously thought incurable tumors. This article briefs about the dimensions of RT in veterinary practice.

Keywords: Radiation therapy, Tumors, Cancer, Brachytherapy, Teletherapy

Introduction

Radiation therapy uses ionizing radiation to treat ailments and solid tumors. Radiation therapy (RT) is sometimes referred to as radiotherapy, X-ray therapy, and radiation oncology. This is most commonly used to treat benign tumors. It can be used alone or in conjunction with other forms of treatment. RT has been used to treat veterinary cancer patients for over 100 years. Only ten years after Wilhelm Roentgen discovered x-rays, the first report of RT in an animal was published in 1905. Over the last 20 years, the use of RT in companion animal oncology has grown and expanded dramatically. RT uses high-energy rays to kill neoplastic cells and is an effective treatment for tumors resistant to surgery or chemotherapy, even in advanced stages of neoplasia. Many neoplasia's are currently being treated with RT to give long-term control (Del Portillo *et al.,* 2020).

The goals of RT include tumor/disease eradication while preserving normal tissue structure and function, curing or shrinking early-stage cancer, stopping metastasis, and treating symptoms induced

by advanced cancer. The basic mechanism of action of RT is to damage the genes (DNA) of neoplastic cells, causing the cells to stop growing. RT directly induces DNA damage, which can be achieved by an electron, proton, neutron, photon, or ion beam directly or indirectly ionizing the atoms that make up the DNA chain. The indirect consequence of RT is the formation of free radical causing water ionization, which damage DNA. Most of the radiation effect is caused by free radicals (Moore, 2002; Fujii *et al.*, 2013).

Indications for radiation therapy

Radical radiotherapy - Given with curative intent in diseases that are responsive to radiation, including cervical, prostate, thyroid, and brain malignancies.

Radiosensitivity	**Types of Tumours**
Tolerant tissue to radiation or radioresistant	Connective, muscular and osseous, nerve tissue tumor, melanoma
Most vulnerable to radiation or highly radiosensitive cancer	Hematopoietic, lymphoid tissue and germ cell tumors
Intermediate sensitivity to radiation or moderately radiosensitive	Squamous epithelium and glandular tissue tumor. Require higher dose of radiation (60-80gy)

1. **Definitive therapy** (the principal component of treatment)
2. **Neoadjuvant therapy** (to shrink a tumor before surgery
3. **Adjuvant therapy** (after surgery to target any microscopic local spread)

Emergency radiotherapy

1. Given to rapidly shrink a tumor mass that is pressing on a vital structure.

Palliative radiotherapy

Given with the aim of attenuating symptoms, not improving prognosis. These can include pain from compression of local structures, pain from bone metastases, neurological symptoms from raised intracranial pressure, dyspnoea and hemoptysis from bronchial tumors.

Acute Side Effects

Dogs and cats are usually affected by moist desquamation. The disease is exacerbated by licking. Radiation burns are followed by the production of crusts, and the skin heals beneath the crusts (about 2-3 weeks). Mucositis occurs when the gums, tongue, cheeks, throat, or other mucus membrane-lined tissue is treated. The mucosa will become extremely red, ulcerate, or blister. It is possible to experience halitosis, drooling, and difficulties eating. If a considerable amount of their jaws is impacted, some cats and small dogs may require a temporary feeding tube. If the eyes are in the treatment field, ocular side effects are a worry. Acute adverse effects include dry eyes, corneal inflammation, and the formation of corneal ulcers. Swelling and edema can produce lumen obstructions such as the trachea and bronchus. During radiotherapy, steroid treatment lowers edema.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 12. 2.2023

Infertility is a result of the higher sensitivity of the gonads to radiation. Anemia occurs as the hematopoietic cells are more prone to radiation damage (Sourati *et al.*, 2017).

Late side effects

These are detected after months to a year after treatment and are due to damage to blood vessels and connective tissue cells. Late effects include fibrosis and thickening of the skin and delayed wound healing, epilation, dryness like dry mouth, loss of taste, dry eye, cataract and retinal degeneration, lymphedema, spinal cord malacia, Kidney fibrosis or scarring, lung fibrosis, cancer (Birgisson *et al.*, 2007).

4R'S of Radiation Therapy

Four important factors affecting cell sensitivity to radiation are referred to as the 4 R's- repair, redistribution, repopulation, and reoxygenation.

X-rays used in radiotherapy

1. **Orthovoltage** - Orthovoltage units use lower energies (150–500 kVp), which are associated with greater skin toxicity.
2. **Megavoltage** - use >1 MV, has a greater penetration depth, and spares the skin, allowing for improved treatment of deep-seated lesions. Megavoltage X-rays are preferred over orthovoltage because of skin sparing effect. Megavoltage radiation predominates in veterinary medicine because of its increasing availability and wide applicability in different tumors.

Teletherapy/External beam radiation therapy or EBRT or XRT

The radiation source is located outside the body, approximately 80-100 cm from the target region. Cancer is the target of the radiation source. Tele-radiotherapy uses a linear accelerator that produces high-energy X-rays or a gamma beam generated by radioactive cobalt 60 sources (Bloomfield, 2015).

Brachytherapy/Internal beam radiation therapy/Sealed source radiotherapy/Short distance therapy

Sealed radioactive chemicals (Gamma or beta emitter) are injected into the tumor or a bodily cavity nearby. It concentrates a large amount of radiation in a tiny region (Ramos *et al.*, 2019). Permanent implants are left in place indefinitely and gradually deliver their radiation dose until the radioactive source decays to a minimal level. Because of the potential radiation risk, this therapy is generally not suggested. However, temporary brachytherapy involves using thin hollow needles, which are used to insert rice grain-sized pellets or seeds into tumors. The radiation source is left in the tumor bed for a set time before being removed once the required dose has been administered. Once the implant is removed, there is leftover radioactivity (Seniwal *et al.*, 2021).

Conclusion

RT has evolved into an important therapeutic tool in veterinary medicine. It can give long-term control of numerous malignancies that previously had no effective treatment. For example, even in individuals with advanced-stage neoplasia, radiotherapy may be an effective treatment for cancer resistant to surgery or chemotherapy. In addition, palliative care procedures aim to improve the

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com
Published 12. 2.2023

quality of life of cancer patients by alleviating pain and resolving or improving clinical symptoms caused by the tumor. Although technological developments in the RT area are more expensive, they have substantially enhanced the safety, precision, and efficacy of this treatment modality for veterinary patients. Therefore, further studies are required to advance this prospective therapeutic strategy in veterinary oncology.

References

A, Ameri A, Malekzadeh M. Acute side effects of radiation therapy. Cham: Springer. 2017.

Birgisson H, Påhlman L, Gunnarsson U, Glimelius B. Late adverse effects of radiation therapy for rectal cancer–a systematic overview. Acta oncologica. 2007 Jan 1;46(4):504-16.

Bloomfield R. (2015). Stereotactic radiation therapy in veterinary medicine. The Canadian veterinary journal = La revue veterinaire canadienne, 56(1), 95–97.

del Portillo Miguel I, Sesanto C, Parys M, Serra JC. Radiation therapy in veterinary medicine: a practical review. UK-VET Companion animal. 2020 Aug 7.

Fujii Y, Yurkon CR, Maeda J, Genet SC, Kubota N, Fujimori A, Mori T, Maruo K, Kato TA. Comparative study of radioresistance between feline cells and human cells. Radiation Research. 2013 Jul;180(1):70-7.

Moore AS. Radiation therapy for the treatment of tumours in small companion animals. The Veterinary Journal. 2002 Nov 1;164(3):176-87.

Ramos MS, Echegaray JJ, Kuhn-Asif S, Wilkinson A, Yuan A, Singh AD, Browne AW. Animal models of radiation retinopathy–From teletherapy to brachytherapy. Experimental Eye Research. 2019 Apr 1;181:240-51.

Seniwal B, Thipe VC, Singh S, Fonseca TC, Freitas de Freitas L. Recent advances in brachytherapy using radioactive nanoparticles: an alternative to seed-based brachytherapy. Frontiers in Oncology. 2021 Nov 24;11:4830.

Official Website
www.thescienceworld.net
thescienceworldmagazine@gmail.com

Published 12. 2.2023