



RADIOTHERAPY- A CURSE OR A BOON

Tiwari Aanshika^{1*}, Agarwal Nitin², Srivastava Ankita¹, Chaudhary Krishankant¹

¹PG Student, ²Professor & HOD, Department of Oral Medicine & Radiology, Career Post Graduate Institute of Dental Sciences, Lucknow, Uttar Pradesh, India.

ABSTRACT

Radiotherapy is the treatment of diseases using ionizing radiation. Ionizing radiation which is used for therapeutic purposes has high energy radiation in the mega voltage range. Radiotherapy may be used for curative or adjuvant treatment. It is used as palliative treatment or as therapeutic treatment. Radiotherapy has several applications in non-malignant conditions, such as the treatment of trigeminal neuralgia, severe thyroid eye disease, pterygium, pigmented villonodular synovitis, prevention of keloid scar growth, and prevention of heterotopic ossification. The use of radiotherapy in non-malignant conditions is limited partly by worries about the risk of radiation-induced cancers. The following review article discusses the role of radiotherapy and its varied clinical implications.

Key words:-Gallbladder, Intrahepatic, Embedded.

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INTRODUCTION

First radiation oncologists cured, from historical record, the first cancer case in 1898. Through the late thirties until after World War II some hardware advances were made to help propel charged particles through a vacuum tunnel called a linac, or linear accelerator. This was used to make a more concentrated penetrable means to send x-rays to cancerous areas deeper in the body while not affecting the skin as much. Two scientists from Stanford, Dr. Henry Kaplan and Edward Ginzton, worked together to bring this up to a standard where it could be used in a clinical setting. By 1960 the work done by these two researchers spawned the first publically launched rotational radiotherapy Linac called the "Clinac 6." The latest advancement in scanning technology within the radiation therapy world is a system called Image Guided Radiation Treatment. The IGRT machine is a delivery

system that uses dynamic CT images of the body that actually compensates for any movement the tumor may have.

SCOPE OF RADIOTHERAPY: Radiotherapy is based on the principle that rapidly proliferating cells are more sensitive to ionizing radiation compared to normal cell. This very property is used in the therapeutic treatment [1,2].

INDICATION: Palliation remains possible upto a comparatively advanced stage of the disease.

- The Reticulosis and the Leukemias
- Hodgkin's disease (lymphadenoma)
 - Lymphofollicular reticulosis
 - Other reticulosis
 - Chronic myeloid leukemia
 - Chronic lymphoid leukemia

In this whole group the disease is systemic from the beginning and radiation is of major palliative and life prolonging in value and thus the treatment of first choice.

Corresponding Author

Aanshika Tiwari

Email: aanshikatiwari03@gmail.com

It may be linked with chemotherapy. Radiation therapy and surgical extirpation both of value.

Predominantly surgical;

- (i) secondary carcinoma in lymph nodes
- (ii) mixed tumor of the parotid
- (iii) tumors of the brain

Radiotherapy is used either as a preoperative or postoperative radiation. Palliative radiotherapy remains possible for most of the inoperable but not hopelessly advanced cases. [3]

Surgery and radiotherapy alternatives: This is usually in the case of carcinoma of the body of the uterus, vulva, penis, skin of the trunk and limbs, and decision has to be made for each case individually, having regard to all circumstances.

Radiotherapy indicated but of limited value

- (i) carcinoma of the larynx (extrinsic)
- (ii) carcinoma of the pharynx
- (iii) thyroid tumors

- (i) malignant salivary gland tumors

In most of these tumors neither surgery nor radiotherapy offers more than limited percentage of cure. In the earlier stages of some of these growths radical radiotherapy offered where the age and general condition of the patient is good. In the later cases of this group useful palliation is often possible for the relief of distressing symptoms but is contraindicated in the absence of symptoms.

(4) Radiotherapy is usually contraindicated in;

- a) Operable resistant types of growth
 - (i) Osteogenic sarcoma
 - (ii) Fibrosarcoma
 - (iii) Other resistant sarcomas (myosarcoma, liposarcoma, etc.)
 - (iv) melanoma

In this group, surgical excision is the treatment of choice; it should be radical and expect no help as a curative measure from radiotherapy. Treatment by radiotherapy not of value in cases like carcinoma of the stomach, intestine, colon or rectum, hypernephroma, carcinoma of the prostate, secondary carcinoma in liver or lung, besides limited surgical treatment or hormonal therapy, treatment is of little value and so rarely provides real palliation.

TYPES OF RADIOTHERAPY: [4,5]

Curative therapy: Here the intention is to eradicate the disease permanently in the treated area.

Palliative therapy: Here the aim is to achieve temporary improvements in the patient's conditions in circumstances where experience has shown that cure is rarely possible.

The technical modalities used for clinical radiation therapy:

1. External (transcutaneous) irradiation: Irradiation from sources at a distance from the body (x-ray, teletherapy with radium-226, cobalt- 60, or cesium- 137)

2. Local irradiation (Brachytherapy): Irradiation from source in direct contact with the tumor:

i) Surface irradiation with applicators loaded with radioactive material (molds for treatment for certain oral tumors like carcinoma of the hard palate and skin tumors).

ii) Intracavitary irradiation with radioactive material (most commonly radium- 226, cobalt- 60, cesium- 137) in removable applicators which are inserted into body cavities, such as uterus, vagina, nasopharynx or maxillary sinus.

iii) Interstitial irradiation by removable needles containing radium- 226, cobalt- 60, cesium- 137; by non removable 'seeds' of radioactive gold- 198 or radon; by small radioactive iridium sources in nylon suture; or by radioactive tantalum- 182 wire. The radioisotopes are implanted into the tumor, eg. carcinoma of the tongue and buccal mucosa.

iv) Direct roentgen therapy to epithelial lesions by means of cones (i.e. transvaginal, intraoral)

3. Internal or systemic irradiation: Irradiation by radioactive sources (i.e. ^{32}P , ^{131}I) administered intravenously or parenterally. Radioactive Iodine is used to treat thyroid cancer, and Phosphorous- 32 is used for treatment of polycythemia vera.

RADIOBIOLOGY: The ionizing radiation when passes through the tissue of a patient affects the biology of both normal and tumor tissues. This radiation causes both direct and indirect effects on biologic targets. Radiation kills by interaction with the water molecules that disrupt the biochemical processes in the cells. The DNA of a cell may be directly affected by the secondary electrons generated as ionizing radiation interacts with tissue. The radiation may also have an indirect effect due to formation of free radicals, these free radicals in turn cause most of the chemical damage to the DNA. In addition there are a number of other cellular functions that are disrupted by radiation induced damage. Chromosomal damage also occurs. This damage is modified by oxygen concentration, temperature and other intercellular components.

The basic aim of radiotherapy is to destroy the tumor, but preserve adjacent normal tissue. Ionizing radiation deposits energy that injures or destroys cells by damaging their genetic material, making it impossible for these cells by damaging their genetic material, making it impossible for these cells to continue to grow. The lethal dose for both normal and abnormal tissue is the same, but normal tissue has a greater ability to repair sublethal damage between doses of radiation than neoplastic cells.

FRACTIONATION OF RADIOTHERAPY:

Fractionation helps to minimize normal tissue reaction. The clinical effects of fractionated radiotherapy are influenced by the ability to repair sublethal damage, re-oxygenation of tumor during the course of radiation, repopulation of the tumor and the normal tissues between fractions and redistribution of the cells into a more sensitive phase in the cell cycle treatment. [6]

The four types of fractionation are:

- (1) Conventional Fractionation: is the application of daily doses of 180- 200 cGy and 5 fractions per week to a total dose of 40- 70 Gy depending on the tumor type.
- (2) Hyper-fractionation: two or more fractions per day of reduced dose (115- 120 cGy) with overall treatment time similar to conventional fractionation.
- (3) Accelerated fractionation: is a means of decreasing the overall duration of treatment in an effort to reduce the repopulation of tumor cells in rapidly proliferating tumors. Tumor repopulation or regeneration occurs during treatment when the overall duration of treatment is increased. Shortening of overall time can increase the tumor control in selected situations.
- (4) Accelerated hyperfractionation: is a method of delivering two or more fractions per day of normal dose per fraction which helps in reducing the overall treatment time without increasing the risk of late complications.
- (5) Concomitant: boost technique, is the variant of accelerated fractionation, where the treatment is delivered once daily for the first three and half weeks and then twice daily for the remaining two and a half weeks, when the tumor can begin to repopulate more rapidly.
- (6) Hypofractionation: in this method less than four fractions per week with higher dose per fraction than what is conventionally given are planned. This method is found to be useful in selective cases example treatment of melanomas.
- (7) Split course therapy: this treatment is given in a small course with a rest period in between.

COMPLICATIONS:

Radiation dysphagia: Most troubling and is least treatable. Patient complains of difficulty in swallowing and food getting stuck in throat. It is caused by radiation fibrosis within the pharyngeal constrictors. The muscles become thick and are unable to contract in coordinated fashion necessary to swallow food. The management includes swallow therapy, improve mouth moisture by taking plenty sips of water and increase liquid content of diet.

Radiation Induced Trismus: Radiation induced trismus without osteoradionecrosis is unique and difficult to treat. Due to fibrosis of muscles example masseter & medial

pterygoid or restrictive fibrosis in the mucosa of anterior tonsillar pillar and retromolar areas during radiotherapy.

Management: Physiotherapy, Mandibular stretching exercises like therabite, tongue blade exercises or by chewing soft and sugarless gums, prosthetic aids & surgical flaps, muscle relaxants, tricyclic medications. [7]

MANAGEMENT OF IRRADIATED PATIENTS:

Before therapy: Caries control, oral prophylaxis, fluoride application. Instruct patient about oral hygiene. Remove teeth with apical pathosis or advanced periodontal disease. Along with any sound teeth in mandible that will be in direct path of radiation. Radiotherapy after 21 days of extraction.

During therapy: Patient may complain of toothache or dental abscess, no invasive treatment should be given, non invasive methods such as pulpotomies, pulpectomies, endodontic treatment analgesics should be followed. No interruption in radiotherapy is required as the cancer cells may repopulate with more radiation resistant cells. [8]

After therapy: Reinforce oral hygiene, first four months are known as golden window period, necessary oral surgical procedures can be done without HBO therapy. After this standard protocol for HBO therapy is recommended for elective surgery in irradiated tissues.

ADVANTAGES OF RADIOTHERAPY: No tissue or functional loss, Better cosmetic outcome compared to surgery, Control of subclinical disease in the regional nodes is possible without added morbidity, Can simultaneously treat multiple primaries, Better surgical salvage of radiotherapy failures than radiotherapy of surgical failures, Rare treatment related mortality. The lesion can be treated in situ and the need for tissue removal is avoided, it is the treatment of choice in T1 and T2 tumors, External beams can be used in such a way, as to protect adjacent, uninvolved tissue, with enhanced effects, using smaller boost fields or combining external beam and interstitial techniques & Treatment of primary tumors of the posterior third of the tongue, oropharynx and tonsillar pillars is easily treated by radiotherapy and surgery is only done for the nodal involvements. [9]

DISADVANTAGES OF RADIOTHERAPY:

Undesirable acute side effects such as painful mucositis, loss of taste, dryness of mouth, Potential late complications of soft tissue and bone, Development of secondary tumors, protracted treatment course & required good infrastructures.

SOURCE OF SUPPORT: None

CONFLICT OF INTEREST: Nil

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