University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 2 (April-June, 2023)

Recent Advancement of Radiotherapy

Research Authors : ***JV'n Muskan Farooq*** Co-Researchers : ***JV'n Punam Londhe and JV'n Priya***
Research Guide- ***JV'n Shaifali Bagriya, Lecturer and JV'n Surbhi Choudhary, Lecturer***
Department of Physiotherapy and Diagnostics, Jayoti vidyapeeth Women's University, Jaipur

Abstract :

Radiatherapy (RT) is very much a technology-driven treatment modality in the management of cancer . RT techniques have changed significantly over the past few decades. Recent advancement have improved the effectivesness , decreased the compilcations, and expanded the implications of radiation therapy. these advances include two - dimensional radiation therapy, three- dimensional conformal radiation therapy, intensity - modulated radiation therapy ,image -guided radiation therapy, stereotactic radiotherapy, brachytherapy, radio immunotherapy. These modalities have improved radiation targeting and also limit the radiation exposure to the normal healthy tissues. Radiotherapy is the chief nonsurgical method and plays an important role in killing, shrinking and controls the size of the tumor. in general radiotherapy treatment provide more accurate, more precise physical and biological targeting. this will allow increase in radiation dose, thus potentially treating the cancer more effectively and thus increasing the treatment value and reduce the toxicity.

Key Words : Image guided radiotherapy, stereotactic radiotherapy, Radiotherapy, tumor, cancer, treatment accuracy, precisely.

Introduction :

RT is the most common treatment technique for curing human cancer.80% of the cancer patient needs radiotherapy for curative or palliative purpose to obtain the optimum result . the delivery of radiotherapy has changed significantly over the last few decades . we have shift from conventional radiotherapy using simple rectangular treatment fields to increasingly conformal radiotherapy techniques such as two - dimensional radiation therapy (2D-RT) , three- dimensional conformal radiation therapy(3D-CRT) , intensity - modulated radiation therapy(IMRT) ,image -guided radiation therapy(IGRT), stereotactic radiotherapy , brachytherapy , radio immunotherapy.

RT is mainly divided into 2 types :-

External beam radiation therapy

Internal beam radiation therapy

EXTERNAL BEAM RADIATION THERAPY :-

2-D RT technique

It is a conventional treatment technique that is followed by the 2-Dimensional images. It includes several steps such as lead markings, setting reference marks, shifting, comparing and compensating the offsets.This technique treats cancer on the basis of primary/basic shapes of cancer as in"German

University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 2 (April-June, 2023)

Helmet" technique for the treatment of brain cancer. As it works on the basis of primary shapes , matching the height and width of the tumor results into a disadvantage because of the exposure to large no. of healthy tissues.

3-D CRT technique

It stands for Three Dimensional Conformal Radiation Therapy as it is followed by 3-D images such as CT images and MRI images.This technique uses the targeting information to focus precisely on the tumor while avoiding the unnecessary exposure to the healthy surrounding tissues.The exact targeting makes it possible to use higher levels of radiation in treatment as it is more effective in shrinking and killing tumors.

IMRT (Intensity Modulated Radiation Therapy):-

IMRT is the advanced technique to overcome the challenges and limitations of conventional radiation treatment delivery technologies by executing the accurate and précised treatment. It uses several tiny radiation beam shaping devices called as collimators i.e. MLC and MMLC to precisely deliver the doses of radiation. The collimator can be stationary or can move during treatment allowing the intensity of the radiation beams to change during treatment sessions. This kind of dose modulation allows different areas of a tumor or nearby tissues to receive different doses of radiation i.e. patients are treated with beams of non- uniform fluences at multiple directions where as each beam is optimized to deliver high dose to the target volume and least to healthy tissues which reduces the risk of side effects and has better control on tumor growth. IMRT can be delivered either with forward or inverse planning. As majorly preferred is inverse planning for IMRT in order to obtain the optimum beam fluence, i.e. inverse planning process is considered as optimization. Optimization basically adjusts the beamlet intensities to satisfy the predefined dose distribution with the help of either analytical method or the iterative method.

IMRT treatment delivery involves :

1. Gantry fixed IMRT - step and shoot
2. Arc based IMRT-
    a. Intensity modulated arc therapy - cone beam
    b. Tomotherapy - fan beam

IGRT (Image Guided Radiation Therapy):-

IGRT is basically an advanced form of IMRT with image guidance throughout the treatment course. In IGRT repeated imaging scans are performed to achieve the maximum precision. These imaging scans are processed by computers to identify the changes in tumor shape, size, location etc so that planned radiation dose and the patient position can be altered/ adjusted in accordance. IGRT increases accuracy rate and treatment value by reducing the total dose to healthy tissues. Nowadays IGRT is the most prescribed cancer treatment technique. IGRT involves on-board imaging i.e. KVCBCT imager and MVCBCT imager

University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 2 (April-June, 2023)

Stereotactic Radiation Therapy :-

It is an EBRT technique that uses combination of stereotactic apparatuses. Multiple non coplanar beams are used for the treatment of small but well defined tumor with tolerance of approximately (+)(-) 1.0mm .Machines used - Gamma knife, Cyber Knife, LINAC based X- knife.SRT uses three modalities of energy for treatment as following X-ray treatment - Uses MV energies, Gamma rays treatment - cobalt is used as a source and Proton Therapy - heavy particles are used as a source (deposits all energy to the target/tumor not in the pathway.

Stereotactic Radio Surgery :-

This technique is used precisely for the CNS (brain and spine)High doses are delivered in single go. i.e. 8-10 Gy in 1fraction.Prescribed mainly for intracranial tumors such as Medulloblastoma , Primary CNS lymphoma, Pituitary adenoma.

Machines used :Gamma Knife machine was popular for specifically performing the SRS technique but nowadays, Cyber Knife and LINAC based X-ray Knife machines are also used to perform SRS technique.

Stereotactic Body Radiation Therapy :-

Stereotactic body radiotherapy (SBRT) is a type of radiation therapy that uses many many beam of energy . SBRT is used to treat tumors in lungs , spine , liver , neck , lymph nodes or other soft tissues. SBRT uses 3D or 4D imaging and highly focused radiation beams to send high doses of radiation to the area to be treated . this result in the least amount of damage to the healthy tissues around area . SBRT usually takes 1 to 5 sessions .

Gamma Knife:-

Gamma knife is a stereotactic radio surgical equipment that are potent for delivery of high doses of radiation focusing precisely to the target point of brain in a single go. Gamma knife is accurate within 0.3mm with overall success rate of ?75%.Co-60 is used as the source of gamma energy.

Cyber Knife:-

Cyber knife is a stereotactic robotic device used for the treatment of lesions all over the body with extreme accuracy. It is referred as staged or fractionated radio surgery as it precisely delivers radiation doses into 1 to 5 fractions in a true robotic manner.In some cases it is also used as alternative or adjuvant/conjunction option to surgery.

Linear accelerator based on x -ray :- is a machine that aims to deliver radiation at cancer tumor with pin point accuracy , sparing nearby healthy tissues . LINAC send radiations such as x-rays or electron beams through the body and into cancer tumor

Cobalt -60:- to overcome the limitation of kilovoltage machines, radionuclides such as cobalt -60, cesium -137 , radium -226 has been used as source of gamma rays. Among those radioisotopes cobalt -60 is mainly available today for use in teletherapy machines .about 50% of all cancer , in terms of anatomy and thickness are amenable to tele-cobalt therapy .

University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 2 (April-June, 2023)

INTERNAL BEAM RADIATION THERAPY:-

Brachytherapy is a cancer treatment in which radioactive material sealed inside in a form of seed, pellet, wire, or capsule is implanted in the body using a needle or catheter. The radiation given off by this source to destroy the DNA of nearby cancer cells.

Brachytherapy is most commonly used to treat prostate cancer. It also can be used for gynecologic cancers such as uterine cancer and cervical cancer as well as, breast cancer ,lung cancer ,rectal cancer ,skin cancer ,eye cancer

Types of brachytherapy :-

Temporary brachytherapy implant :- A radiation source is placed within or near the tumor target and is subsequently removed. It is used for the treatment of Cervical cancer, sarcoma, vaginal cancer, oral cavity cancers

Permanent brachytherapy implant :- A low-dose rate (i.e., long half-life) radiation source is placed within or near the tumor target. used for Prostate cancer

Systemic radiation therapy :- A type of radiation therapy in which a radioactive substance, such as radioactive iodine or a radioactively labeled monoclonal antibody, is swallowed or injected into the body and travels through the blood, locating and killing tumor cells.

ABBREVIATIONS :-

RT	:	Radiation Therapy
2D-RT	:	Two dimensional -radiation therapy
3D-CRT	:	Three dimensional -conformal radiation therapy
IMRT	:	Intensity modulated radiotherapy
IGRT	:	Image guided radiation therapy
LINAC	:	Linear accelerator
SRS	:	Stereotactic radiation surgery
SBRT	:	Stereotactic body radiation therapy
CNS	:	Central nervous system
MV	:	Mega voltage
CT	:	Computer tomography

Acknowledgements :- we would like to thanks our prestigious university jayoti vidyapeeth womens university for providing such a great opportunity especially I thank to the Lecturer jv'n shaifali Bagriya , lecturer jv'n surbhi choudhary , lecturer Tarini Sinha for providing the necessary facilities to conduct this review .

Conclusion :-

In conclusion, RT has undergone tremendous progress over the years, realising technological developments that have revolutionised its clinical use, but we must not forget the multifaceted nature of

this discipline that makes it an interface between physics, chemistry, biology and medicine.Only by exploring all these aspects will we manage to produce individualized radiation therapy with better target delineation, avoidance of normal tissue, dose escalation, dose fractionation and better prediction of treatment response.

Reference :-

- Basic radiological physics = kuppusamy thayalan
- [PubMed] [Google Scholar] https://www.aafp.org/pubs/afp/issues/2008/1201/p1254.html#:~:text=Recent%20advances%20have%20improved%20the,radiotherapy%2C%20brachytherapy%2C%20and%20radioimmunotherapy
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5718253/
- https://bmcmedicine.biomedcentral.com/articles/10.1186/1741-7015-8-25
- https://www.slideshare.net/SubrataRoy4/recent-advances-in-radiotherapy-techniques
- Human anatomy = bd chaurasia