MANGALORE UNIVERSITY

MSc Medical Physics

MPS 553: Modern Trends in Radiotherapy (Radiotherapy – II)

Teaching hours: Each Unit – 12 h

To familiarise the students various aspects radiation therapy, different techniques and instruments used in planning radiation therapy and treating the patients.

Outcomes:

- Students will be able to analyse the imaging data and planning the treatment process.
- They will learn about stereotactic radiosurgery and radiotherapy and quality analysis procedures.
- They will learn in detail all the aspects of intensity modulated radiation therapy and quality analysis protocols.
- Students will be able to plan and deliver tumor specific dose using external photon beam.
- Students develop acquaintance with patient positioning guidelines and isocentric setup for radiation therapy.
- Familiarise with all aspects of brachytherapy including planning, dose calculation and treatment.
- Also familiarise with all aspects of electron beam therapy including planning, dose calculation and treatment.

Unit I: Three –dimensional Conformal Radiation Therapy (3DCRT)

Treatment planning process – imaging data – computed tomography – magnetic resonance imaging – image registration – image segmentation –field multiplicity and collimation – plan optimization and evaluation – Doe volume histogram(DVH) – Dose computation algorithms. **Special techniques in radiation therapy**: Total body irradiation (TBI) – large field dosimetry – total skin electron therapy (TSET) – electron arc treatment and dosimetry – intraoperative radiotherapy.

Unit II: Advancements in Conformal Radiotherapy

Stereotactic radiosurgery /radiotherapy (SRS/SRT) – cone and mMLC based X-knife – Gamma Knie – immobilization devices for SRS/SRT – dosimetry and planning procedures – Evaluation of SRS/SRT treatment plans – QA protocols and procedures for X and Gamma

Knife units – Patient specific QA. Physical, Planning, clinical aspects and quality assurance of stereotactic body radiotherapy (SBRT) and Cyber Knife based therapy.

Intensity modulated radiation therapy (IMRT) : principles – MLC based IMRT – step and shoot and sliding window techniques – Compensator based IMRT – planning process – inverse treatment planning – immobilization for IMRT – dose verification phantoms, dosimeters, protocols and procedures – machine and patient specific QA. Intensity Modulated Arc Therapy (IMAT e.g. Rapid Arc). Image guided Radiotherapy (IGRT) – concept, imaging modality, kV cone beam CT (kVCT), MV cone beam CT (MVCT), image registration, plan adaption, QA protocol and procedures – special phantom, 4DCT. Tomotherapy – principle – commissioning – imaging – planning and Dosimetry – delivery – plan adaptation – QA protocol and procedures.

Unit III: Tumor dose Specification for External Photon Beams

Gross Tumor volume (GTV), Clinical target Volume (CTV), Internal target volume (ITV), Planning Target Volume (CTV) and Organ at risk (OAR) – Treated volume, Irradiated volume, Maximum target Dose, Minimum Target Dose, Mean Target dose, Median Target dose, Modal target dose, Hot spots - ICRU 50 and 62. Patient positioning: general guide lines – XYZ method of isocenter setup.

Unit IV: Brachytherpay Treatment Planning and Dose Calculation

Purposes of Brachytherapy Treatment Planning, Prescription points for vaginal cylinder, T&O, esophagus, endobronchial, and bile duct treatments, Treatment site, disease, prescribed doses, isodoseline/prescription points, isotopes, applicators used, Contrast, markers, skin wires, Target and critical organs, Applicator insertion, T&O implants, total source strength and exposure time (or dose), Seeds alone vs. boost prostate implants, indexer lengths , Catheter numbering in interstitial implants, Use of spacers, ICRU Report 58 Quantities, RTOG 9517, Accelerated Partial Breast Brachytherapy, Differential DVH for Optimized Plan, Simplified analytical solutions (unfiltered line source Sievert integral), Use of classical implant systems(Manchester, Quimby, Paris) for interstitial implants.

Unit V: Electron Beam Therapy Treatment Planning and Dose Calculation

Effects of patient and beam geometry Air gap, Beam obliquity, Irregular patient surface, Internal heterogeneities: bone, fat, lung, air, Dose algorithms, Analytical algorithms (e.g.,

Fermi-Eyges based pencil beam), Monte Carlo algorithms, Clinical commissioning, Quality assurance of treatment plans, Treatment planning techniques, Energy and field size selection, Bolus: Constant thickness and shape, Collimation: Inserts, skin, internal, Field abutment techniques Photon-electron mixed beams, Special electron treatment techniques, Total skin irradiation, Total limb irradiation, Electron arc therapy, Intraoperative electron therapy, Total scalp irradiation, Craniospinal irradiation, Conformal therapy.

Reference Books:

1. R.F.Mould, –Radiotherapy Treatment Planning Medical Physics Hand book series No.7, Adam Hilger Ltd, Bristol, 1981.
2. S.C.Klevenhagen –Physics of Electron Beam Therapy‖ Medical Physics Hand Book Series No.6 Adam Hilger Ltd, Bristol, 1981.
3. F.A.Attix –Radiation Dosimetry‖ Vol IIII, Academic press New York, 1985.
4. FahizM.Khan, Treatment Planning in Radiation Oncology, LWW publication, Second Edition
5. Ann Barrett, Jane Dobbs, Stephen Morris and Tom Roques. –Practical Radiotherapy Planning‖ Fourth Edition 2009
6. –3D Conformal and Intensity Modulated Radiation TherapyPhysics and Clinical Applications‖ by James A Pondy
7. –Contemporary IMRT Developing Physics and Clinical Implementation‖, S. Webb.
8. New Technologies in Radiation Oncology‖ W. Schlegel ・T. Bortfeld・A.L.Grosu.
9. –The Physics of Conformal Therapy Advances in Technology‖ by S.Webb
10. A Practial Guide to CT simulation‖, by Lowrence Coy.
11. The Physics of Medical Imaging, S.Webb, Medical Science Series, Adam Hilger, Bristol,1984.
12. Therapeutic Applications of Monte Carlo Calculations in Nuclear Medicine‖ HabibZaidi, George Sgouros IOP, Institute of Physics Publishing, Bristol and Philadelphia.

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