ASSOCIATION OF RADIATION ONCOLOGISTS OF INDIA

Quarterly Newsletter

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RADIOTHERAPY IN MYOSITIS OSSIFICANS -A MIOT EXPERIENCE

Dr. V. Srinivasan., M.D., F.I.P.M., F.I.C.R.O.

MIOT INTERNATIONAL HOSPITAL, in which MIOT stands for MADRAS INSTITUTE OF ORTHOPAEDICS & TRAUMA, is a renowned Orthopaedic Speciality Hospital in Asia. We use Radiotherapy pre-operatively for Myositis Ossificans from 2012, and we are sharing our data for the last five years.

Introduction

Myositis ossificans (MO) is a progressive but self-limiting de novo trabecular bone formation occurring at skin, subcutaneous tissue, and skeletal muscle and periarticular tissues in which ossification doesn't occur in normal conditions. This ectopic bone tissue, induced by osteoblastic activity, is an extra-articular bone localized to adjacent areas of joint and the joint capsule is generally intact. It involves large joints such as hip, elbow and knee. It generally appears 1-4 months after trauma, but it may also occur a few years after trauma. Clinical symptoms and signs become apparent at late phase. MO is classified according to Broker's Grading Scale scoring system in lower extremities and Hastings and Graham Grading Scale scoring system in upper extremities.

In general, trauma increases the incidence of myositis ossificans.The incidence is 11-76% after head injury, 18-37% after spinal cord injury, 2-7% after total hip prosthesis, 1-3% after burns, and 0.5-1.2% after cerebrovascular events.

The diagnosis and management is of importance in MO which is frequently observed in orthopedic patients and those undergoing neurological rehabilitation. Treatment options include physical therapy to protect range of motion, drug therapy (etidronate, non-steroidal anti-inflammatory drugs), Radiotherapy, and resection of ectopic bone tissue in joints with severe dysfunction.

Prophylaxis is more important than treatment in myositis ossificans. Early mobilization is of importance in these patients. Risk factors should be eliminated in the development of myositis ossificans. In addition, Radiotherapy and NSAIDs have major role in the prophylaxis of myositis ossificans.

Demographic characteristics of patients

We retrospectively reviewed patient files and/or electronic data of 25 patients who presented to Radiation Oncology Department of MIOT Institute of Cancer Cure with and/or prevention of MO and were treated between 2016 and 2021. Data regarding age, gender, history, etiology, radiological techniques, drugs used, treatments received, treatment-related complications and follow-up times were extracted from patient records

RT and Medication

Patients enrolled for radiotherapy to prevent myositis ossificans were simulated in GE Discovery IQ CT scanner with patient's comfortable position like hand above head or by the sides as much distance as practicable from body for elbow fractured patients. For hip fracture patients, the setup was head first supine with knee and foot rest. Along with CT reference fiducials, body markings were done to exactly reproduce the simulated position in treatment room, particularly to maintain relative position between humerus and fore arm.

The planning CT images with 2.5 mm slice thickness were imported to Eclipse V13.6 treatment planning system. Appropriate Couch structure was inserted to account the attenuation. Treatment planning for elbow was done with 6 MV X – Rays, AP PA ports with outer flash margin of 2 cm and medial skin strip was spared. For Hip 10MV X – Rays were used. The prescribed dose of 7Gy in single fraction was calculated with AAA algorithm. The plan was reviewed by Radiation oncologist and approved for treatment.

The planning isocenter coordinates were transferred and treatment delivered with portal image verification on TruebeamSTx Linear Accelerator.

Lt. Elbow	6
Rt. Elbow	9
Lt. Hip	4
Rt. Hip	5
Lt. Knee	1
Total	25

CT SIMULATION AND RT PLANNING FOR RADIATION

PATIENT DETAILS FROM 2016 TO 2021(Consent Obtained)

S.No	M.R.No	Name	Age	Sex	Site	Dose
1	487189	Shanthi	52	F	Lt. Elbow	7 Gy
2	619686	Amsa K	57	F	Rt. Elbow	7 Gy
3	534571	Mohammed Samiullah	49	M	Lt. Elbow	7 Gy
4	631549	Vinoth S	30	M	Rt. Hip	7 Gy
5	632729	Nagendra Rao	69	M	Rt. Hip	7 Gy
6	632756	Geetha G	50	F	Rt. Hip	7 Gy
7	631294	Chethan Kumar A	29	M	Lt. Knee	10 Gy / 2f
8	548088	Jareena	59	F	Lt. Hip	7 Gy
9	566526	Vivek S	30	M	Rt. Elbow	7 Gy
10	637659	Srinivasan V	38	M	Rt. Elbow	7 Gy
11	563595	Karthick S	23	M	Lt. Elbow	7 Gy
12	638119	Vadamodulu S Kumar	28	M	Rt. Elbow	7 Gy
13	569410	Bharath Kumar S	27	M	Rt. Hip	7 Gy
14	576951	Arunvelan K	23	M	Rt. Elbow	7 Gy
15	581917	Fathima S Z	51	M	Lt. Hip	7 Gy
16	641985	SundarRajulu	53	M	Rt. Elbow	7 Gy
17	657446	Arun Raj G	24	M	Rt. Elbow	7 Gy
18	635375	Shanti B	28	F	Rt. Elbow	7 Gy
19	628241	Balakrishnan D	31	M	Lt. Elbow	7 Gy
20	661779	Yogesh A	16	M	Rt. Elbow	7 Gy
21	405217	Gamaleldin Mohammed	51	M	Lt. Hip	7 Gy
22	603915	Avanthi chukka	28	M	Rt. Hip	7 Gy
23	601261	Said Mohameed	21	M	Lt. Elbow	7 Gy
24	577508	Sanjay Kumar	35	M	Lt. Elbow	7 Gy
25	487256	Abdulla omar	49	M	Lt. Hip	7Gy

Treatment Response and Follow-up

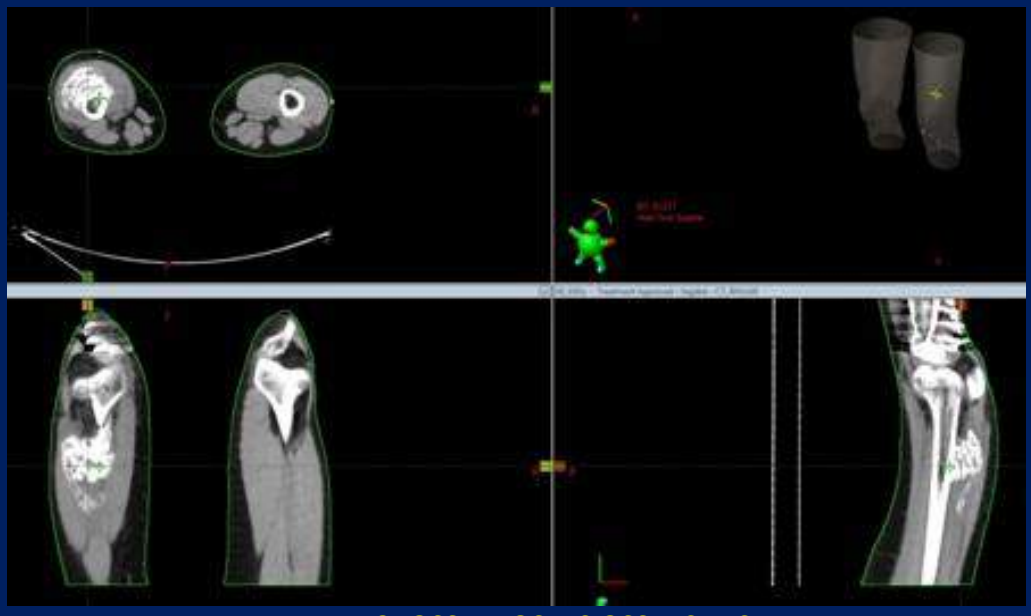
All patients were assessed on the months 1 and 3 after completion of Surgery. The assessment included physical examination, direct radiographs and/or CT scan. Radiological assessments were performed according to ossification degree (0-4 points) by using Broker's Grading Scale for lower extremities and Hasting and Graham Grading Scale for upper extremities. Unresponsiveness was defined as increased ossification scores in radiological assessment after completion of radiotherapy.

Median follow-up was 24 months (range: 2-60).Outcomes were assessed according to the physical examination and radiological evaluations. There was no increase in Broker's ossification score in patients who received radiotherapy. **It was seen that radiotherapy was effective by 98% based on clinical prophylaxis**. Of the patients received prophylactic radiotherapy for elbow joint, it was seen that there was no increase in radiological Hastings and Graham ossification scores.

Myositis ossificans was first described with its clinical, pathological and radiological characteristics in patients with traumatic paraplegia (paraosteoarthropathy) by Dejerine and Ceillier at 19th century. In the literature, de novo periarticular bone formation is denoted with several terms including myositis ossificans, heterotopic ossification, paraosteoarthropathy, neurogenic ossifying fibromyopathy.

Although MO has been known for over a hundred year, there is an ongoing debate regarding etiology, pathogenesis and management.

Pathophysiology of myositis ossificans isn't fully elucidated. It is suggested that MO may result from metaplastic response of mesenchymal cells induced by interaction between systemic factors and local, metabolic, vascular, genetic and biochemical factors. Immobilization, pressure ulcers, trauma, fracture, dislocation, burn, infection, hematoma and several neurological disorders are implied in the etiology. Swelling, effusion, erythema and warmth as well as pain appear 2 weeks after trauma. Localized mass, pain and limitation of movement are typical in the course of disease. These clinical symptoms are seen within 8-10 weeks.



GROSS MYOSITIS OSSIFICANS

Laboratory and Imaging studies will be helpful in diagnosis. Direct radiographies are invaluable in the diagnostic process, as MO become visible on direct radiographs after 1-2 months, where maturation occurs. CT Scans can reveal both MO localization and its relationship with adjacent tissues as well as it is valuable as a guide for treatment. Road Traffic accident (spasticity, prolonged coma, and immobilization) and hip fractures were primary risk factors in our study. It was most frequently observed at hip joint; followed by elbow. The most common complaints were pain and limitation of movements.

Our findings were consistent with literature.In our study, RT was given to 25 patients in order to prevent MO. By the principle that it could be more effective in patients underwent total hip arthroplasty, combined therapy (RT plus NSAID (Indomethacin) was prescribed together.

Literature Review

There are several studies regarding the timing and dose delivered of radiotherapy in the literature. It has been shown that radiotherapy is more effective in the early phase of MO. It is recommended that surgery alone increases recurrence rates and radiotherapy should be given at preoperative and early postoperative period to prevent recurrence. It is recommended that radiotherapy should be given within first 72 hours after surgery.In a study Kantorowitz et al., a significant difference was found between delivery of radiotherapy (7 Gy) 4 hours before surgery and radiotherapy (7 Gy) given within first 72 hours after surgery regarding MO prevention. Authors reported that preoperative radiotherapy was more effective.

In a study on patients undergoing total hip arthroplasty by DeFlitc et al., radiotherapy was given within first 72 hours to 75% of patients to prevent MO and authors reported that MO developed in 55% of these patients. In the studies by Rumi et al. and Seegen et al., it was reported that both preoperative and postoperative radiotherapy prevented MO by 85-95% in patients at high risk for MO development.

It is recommended to give early postoperative radiotherapy at fractionated doses (total dose of 10 Gy) or at a dose of 6-8 Gy at single fraction in order to prevent recurrence after surgery. Previous studies demonstrated that there was no difference between single dose and fractionated doses. However, single dose radiotherapy is more widely preferred due to its ease application. In a study by Hedley et al., single dose radiotherapy (6 Gy) was shown to be effective in 17 patients who underwent hip arthroplasty. This finding indicated that minimum effective dose was 6 Gy in preventing MO development.

In a study, Healy et al. compared single doses with 5.5 Gy and 7 Gy in preventing MO. In that study, MO formation was observed in 63% of the patients received single dose radiotherapy with 5.5 Gy, while, it was observed in only 10% of the patient received single dose radiotherapy with 7 Gy. In another study, perioperative radiotherapy was given to 9 patients who underwent surgical resection for myositis ossificans that was already present at elbow. Radiotherapy was delivered with a total dose of 10 Gy in 2 fractions in 5 patients, whereas remaining 4 patients received single dose radiotherapy with 6 Gy. After mean follow-up 7 months, no radiological recurrence of myositis ossificans was observed in any of the patients, and authors suggested that prophylactic radiotherapy was effective.

In Conclusion, radiotherapy in combination with anti-inflammatory drugs is an effective treatment algorithm in patients at high-risk for MO development such as those undergoing total hip replacement. However, there is a need for further clinical trials with larger sample size that assess effectiveness and adverse effects of prophylactic RT in MO according to age groups.

In Our Institute the success rate in prevention of Myositis Ossificans is nearly 98 % and all the patients who had restricted mobility of joints recovered well after Pre-Operative RT ideally given the day before surgery and their joint mobility were restored to near normal condition.

Reference:

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Low Dose Radiation Therapy Immunomodulation -A New Hope In COVID Treatment Landscape

Dr Kanika Sood Sharma & Dr Aditi Tanwar

Introduction

Amidst medicine, prayers and hope, radiation is trying to find a place in improving the clinical outcome of patients suffering from COVID – 19. Radiation emerged as a hope due to its promising results in treating Pneumonia in the past century and also because of its potential in treating inflammatory diseases. Several trials are underway all over the world to test the safety and efficacy of low dose radiation (LDRT) in COVID-19 pneumonia.

Patho-physiology of COVID induced ARDS

COVID-19 induced pneumonia consists of an initial phase and an advanced phase. In the initial phase host immune response is strengthened to reduce the initial viral load. Whereas in the advanced phase, there occurs immune overreaction which leads to increased production of cytokines / chemokines by immune cells and endothelial cells thereby leading to hyperinflammation due to cytokine storm (CS). This leads to severely damaged alveolar gas exchange leading to lower blood oxygenation. There occurs accumulation of pretentious exudates and formation of hyaline membrane in the alveoli leading to formation of mucous plugs which further reduces the gas exchange. These proinflammatory cytokines also integrate into coagulation pathways majorly through the extrinsic pathway involving tissue factor and factor VII A. Hence coagulopathy is a frequent finding seen with excessive systemic inflammation and is a distinct feature of advanced stage COVID-19.

Rationale of using LDRT

This unconventional use of radiation in the treatment of pneumonia due to COVID-19 is due to its anti-inflammatory and immunomodulatory effects. Immune cells and endothelial cells (both are cytokine generating cells) have the same radio-sensitivity. LDRT targets both these cells and temporarily suppresses the cytokine storm (CS).

The lung epithelial cells are relatively resistant to radiation hence they will be less damaged leading to maintained alveolar gas exchange. Radiation also induces cell apoptosis which helps in improving the absorption of the alveolar mucous. Also,radiation induced modification of microvasculature leads to renewal of endothelial cells thus improving gas exchange.

The Macrophages are segregated into 2 phenotypes-M1 (Proinflammatory) and M2 (anti-inflammatory).The radiation dose of < 1 Gy leads to anti-inflammatory state due to polarization of M2 macrophages.Whereas a dose > 1 Gy causes polarization of M1 macrophages creating a proinflammatory microenvironment.

Case Selection and timing of LDRT

To derive the maximal benefit for low dose radiation immunomodulation optimization is the keyi.e.optimal dose delivery at an optimal time to an optimally selected patient.Thetherapeutic window of delivery of LDRT is narrow ;and the early pulmonary phase is recognized as the most effective phase. The ongoing PRE-VENT trial which is aimed at reduction in requirement of mechanical ventilation is including COVIDpatients symptomatic with fever, cough and/or dyspnoea for < 9 days as this is the window of opportunity of intervention.

The patients with severe disease on mechanical ventilation and established lung fibrosis do not benefit from LDRT.The patients who are unresponsive to steroids and remdesivir may be considered the right candidates for LDRT.With a rise in cases of steroidinduced Mucor-mycosisin COVID survivors the option of LDRT as an alternative to steroids should be given a due consideration.

Most studies prefer to deliver LDRT to patients aged more than 60 years for the anticipated risk of

secondary malignancies. Although many trialists (including one from IRCH and PRE-VENT trial)have delivered radiation to patients as young as 50 years also.

Technical and Logistic Considerations-Before embarking upon LDRT there are many technical and logistic considerations to be addressed.Ideally LDRT should be delivered in a trial setting or else an ethical clearance from the institutional IRB is desirable.The safety of healthcare personnel involved in treatment execution is of prime importance.Appropriate Personal Protective Equipment must be provided to healthcare personnel.TheLINAC vault must be a negative pressure room i.e.air pressure inside the room is lower than the air pressure outside the room**.** Also theCOVID patients treatment should be scheduled at the end of the day, following which the treatment room must be disinfected by infection control team as per the institutional protocol.

Treatment Planning considerations The aim of treatment is to treat both lungs with a single exposure of photons(6 or 10MV) **.**The preferredset up is hand first supine position on couch.Breast board can be used if patient needs a proppedup position ;providing semi fowler position with head and shoulder elevation.

Delivery Technique – AP/PA technique with dose calculation at the mid-plane (with SSD 100cm preferable)at a depth as determined of diagnostic CT scan/inter-parietal distance.

For sick patients, who cannot be transferred to treatment coucha single 6 MV photon PA field (or AP field)can be delivered on the trolley.Treatment can be done by a single open field, placed clinically with twice the MUs.Open field with jaws or open field with MLCs can be utilized. The treatment planning timecan be further minimized by adopting Manual calculation.Treatment delivery in emergency treatment module feature can be utilized but a time-out procedure must be carefully designed to avoid any catastrophic errors.

If conformal radiation is contemplated then prior diagnostic scan can be utilized for planning.The planning treatment volume includes Lungs + 1.2 cm margin& the treatment field should be inclusive PTV with an additional 8 mm margin..As the density of lung is most likely to change in COVID-19 patients the same should be accounted for as per TG 17 during dose calculation.

Dose Selection-

Varying dose schedules have been tested in the published trial with dosages ranging from 0.3 Gy to 1.5 Gy in one fraction.The most common schedule used is 0.7 Gy. An ongoing PRE-VENT trial is investigating 2 dose schedules(0.35 & 100cGy).The schedules with dosage > 1 Gy are considered proinflammatory and also having higher risk of secondary malignancies.So a dosage upto 1 Gy may be considered reasonable for immunomodulation.

Response evaluation criteria-The end points to determine efficacyinclude the pulmonary parametersi.e. is improvement in saturation ,reduction in oxygen requirement and decrease in requirement of ventilatory support.Inflammatory markers such as CRP,IL6,Ferritin and D Dimer are also used as objective markers to evaluate the immunomodulatory effect. Serial radiological assessment can also establish the benefit of LDRT.

Conclusion-There is a body of Indian as well as international data building up reflecting the benefit of LDRT in immunomodulation. The utilization has been restricted due to ethical, logistic and technical hurdles. The second peak of COVID 19 has created a felt need for re exploring this modality to reduce the healthcare burden in form of decreased requirement of ventilatory support and reduction in risk of secondary infections like mucor-mycosis.

It is logical to commission this modality in our set ups as a preparedness for the third wave. Although there will still be some concerns regarding the usage in younger age group. Alsoidentifying the indications of LDRT in context of safe and effective vaccines as well as improved anti-viral and anti-inflammatory strategies is essential.The trials in progress may further fill up the lacunae in the current knowledge.

Reading Resources-

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2.Low dose radiation therapy for COVID-19: Effective dose and estimation of cancer risk Trinitat García-Hernández , Maite Romero-Expósito ,Beatriz Sánchez-Nieto Volume 153, December 2020, Pages 289-295

3. Mitigating Coronavirus-Induced Acute Respiratory Distress Syndrome by Radiotherapy. TrinitatGarcía,HernándezaMaite Romero, Expósitob Beatriz Sánchez- Volume 153, December 2020, Pages 289-295.

4.Low-dose radiotherapy for COVID 19: A radioimmunological perspective. Kumar R, Haresh KP, Sharma DN, Gupta A, Gupta S, Vellaiyan S, *et al*. Low-dose radiotherapy for COVID-19: A radioimmunological perspective. J Can Res Ther 2021

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Acknowledgement – Dr Vineeta Goel (Director and Head Radiation Oncology,Fortis Shalimar Bagh)

CONGRATULATIONS

Winners of 38th AROI-ICRO Teaching Course

Name : Dr Adila A
Institute : AIIMS NEW DELHI
Guide : Prof Sushmita Pathy
HOD: Prof D N Sharma

Dr.Aviral Rastogi
Name of the Institute- All India Institute of Medical Sciences, Rishikesh
Name of Head of Department- Professor Manoj K Gupta

Name – Dr Bhanu Vashistha
CMC, Ludhiana
HOD- Dr.Jaineetsachdeva
Thesis in-charge-Dr. Pamela Jeyaraj

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MOU & TIE UP

INFORMATION FOR THE MEMBERS

Association of Radiation Oncologist of India has done tie up with **CoverYou &** authorize them to provide carefully drafted Doctors Professional Indemnity with specially designed benefits & 80% savings on premium through ICICI Lombard General Insurance Co. Ltd**.** We welcome all members of Association of Radiation Oncologist of India to utilize this opportunity and register themselves under the umbrella of AROI branch Professional Indemnity Scheme. Currently CoverYou is working with 15+ medical association and has vast experience of providing customized policy to healthcare sector professionals and handling their claims.

Members with existing indemnity policy can also register under this AROI branch Indemnity Scheme, their existing retroactive date will be transferred to new policy by providing a copy of existing running policy.

HIGHLIGHTS OF THE POLICY

1. **Source of Notices:-** All source of notices received by member regarding medical negligence are covered under the policy including lawyer notice, district court, state commission, national commission, medical council notices, police FIR, minority commission etc.

2. **Defense Cost:-** We have created medico legal lawyer panel to fight medico legal cases on the behalf of members & legal cost to be born by the insurance co. to defend the case in the court. Members can choose their own preference of lawyer also, his/her fees will be paid as per their professional fee chart.

3. **Cashless Compensation:-** Compensation will be paid by the Insurance Co. directly if doctor loses the case in the court. Multiple claim amount shall be paid up to the sum assured within the policy period. Even if there is a single claim, the maximum compensation up to sum assured will be paid.

4. **Out of court settlement:-** Provision of out of court settlement if case becomes indefensible limiting up to sum assured.

5. **Senior Doctor Legal Cell:-** We have created a Senior doctor panel from AROI for 2nd level opinion. The same which will be given to member after lawyer consultation.

6. **Loss of documents:-** Cases arising out of any loss of critical documents to be covered under the policy.

7. **Medical Establishment:-** Medical Establishment policy will cover all individual policy benefit along with coverage of all qualified & unqualified staff, ward boy, nurses, technicians, owners, director & partners.

8. *This policy would also covers payment of defense cost for criminal cases arising out of medical mishaps once doctor is acquitted/ exonerated from the case.*

9. **Dishonesty From Profession:** Policy covers allegation from patient for dishonesty from profession.

10. **Compulsory Excess -** Compulsory excess under the policy is only 0.25% of the claim amount or Rs. 12500 which ever is higher.

Discounted Premium Chart (Including GST)

Sum Assured	AROI Members
50 Lacs	Rs. 2,124
70 Lacs	Rs. 2,973
1 Cr.	Rs. 4,248
2 Cr.	Rs. 8,496

Medical Establishment Premium Chart (Including GST)

Chairs	20 lacs	40 lacs	60 lacs	80 lacs	1 Cr
1-10 Chairs	3252	5483	7713	10655	12390
11-15 Chairs	7310	9045	10799	12514	14249
16-20 Chairs	9169	10903	12638	14372	16107
21-30 Chairs	11027	12762	14496	16231	17966
31-40 Chairs	12886	14620	16355	18089	19824

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In order to ensure uninterrupted publication of Journal of Cancer Research & Therapeutics, all the state chapters of AROI are requested for timely contribution.

It will be highly appreciated.

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Thanking you

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Dr. Rajesh Vashistha,
President AROI
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14th AROI ICRO Radiobiology Teaching Course (Webinar) Organized by AIIMS, Rishikesh

The 14th AROI ICRO Radiobiology teaching course was conducted on a virtual platform on 07th to 10th September 2021, organized by AIIMS Rishikesh. A short inaugural ceremony on the 07th September was attended online by AROI & ICRO office bearers. An introduction to the course along with introduction of the course director Prof Manoj Gupta was done by Dr. V. Srinivasan, Secretary ICRO.This was followed by opening remarks from Dr.Palkonda Vijay Anand Reddy - Chair AROI ;Dr. Rajesh Vashistha - President – AROI ; Dr. G.V. Giri - Secretary General – AROI ;Prof. Manoj Kumar Gupta - President Elect – AROI and Dr.Satyajit Pradhan - Chairman – ICRO

Overwhelming response was received from both national and international Radiation Oncology community towards the course.A total of 853 registrations were received, 253 international and 600 national. International participants were from Malaysia, Ethiopia, Myanmar, Bangladesh, Thailand, Indonesia, and Kenya. The course was conducted by Prof. Manoj Gupta as the sole faculty from 5.30 pm to 7.30 pm on all four days. The course covered all basic aspects of radiobiology as well as advanced techniques like stereotactic radiotherapy and reirradiation. The contents of the course and the clarity of teaching of Prof Manoj Gupta were greatly appreciated by participants.

Dr. Deepa joseph, Additional Professor in Radiation Oncology, AIIMS Rishikesh assisted as coordinator. The program was supported by INTAS pharmaceuticals.

Dr.Satyajit Pradhan	Dr.D.N. Sharma	Dr.V.Srinivasan
Chairman, ICRO	**Vice-Chairman, ICRO**	**Secretary, ICRO**

Breast MCQs

1. **Which of the following is true about BRCA associated cancers?**
   A) BRCA 1 and 2 genes are located on chromosomes 17 and 12 respectively
   B) Individuals with mutation have a 25% chance of passing to next generation
   C) Bilateral salpingo-oopherectomy is recommended as early as possible regardless of age and completion of family
   D) In males, mutation in BRCA 2 implies 20-305 life time risk of prostate cancer and 5-10% of male breast cancer

2. **In conventional planning of breast cancer RT, central lung distance is used as a predictor of percentage of ipsilateral lung volume treated by tangents. A CLD of 2.5cms suggests what percent of lung is irradiated?**
   A) 6%
   B) 16%
   C) 26%
   D) 36%

3. **As per RTOG guidelines, recommended schedule for HDR interstitial brachytherapy used as APBI is**
   A) 38Gy/12 fr
   B) 36Gy/10fr
   C) 34 Gy/12fr
   D) 34Gy/10fr

4. **Fast Forward trial has suggested that-**
   A) 40Gy in 15 fractions is non inferior to 50Gy/25 fractions
   B) Simultaneous integrated boost for post operative tumour bed boost can lead to fast forwarding of the treatment schedule
   C) 26Gy in 5 fractions is non inferior to 40Gy/15 fractions
   D) 18Gy in 3 fractions is non inferior to 26Gy/5 fractions

5. **The limit for maximum skin dose for Mammosite implant as per RTOG 0413 is**
   A) ≤ 145% of prescription dose
   B) ≤ 135% of prescription dose
   C) ≤ 140% of prescription dose
   D) ≤ 150% of prescription dose

6. **According to 'Proton therapy for breast cancer- A consensus statement from the Particle Therapy Cooperative Group Breast Cancer Subcommittee' recommendations, while treating breast cancer with proton beam therapy, the mean dose to all quadrants of contralateral breast should be limited to**
   A) < 1Gy
   B) < 2Gy
   C) < 3Gy
   D) < 4Gy

7. **As per ESTRO contouring guidelines for carcinoma breast radiation therapy, the cranial limit for internal mammary nodal chain CTV is**
   A) Superior aspect of medial 1st rib
   B) Inferior aspect of medial 1st rib
   C) Caudal limit of SCF
   D) 2nd rib insertion

8. **After breast conservation surgery and radiotherapy for triple negative breast cancer, the maximum chances for recurrences are**
   A) After 10 years
   B) In first 3 years
   C) After 15 years
   D) low at all time points

9. **Which of the following is a 50-gene signature based test in breast cancer?**
   A) Oncotype Dx
   B) Mammaprint
   C) Mammolife
   D) Prosigna

10. **The Gail model used for calculation of a woman's risk of developing breast cancer is based on all of the following except :**
    A) Age at menarche
    B) The number of first- and second-degree female relatives with breast cancer
    C) Age at first live birth
    D) Numerous of previous breast biopsies

11. What is the incidence of axillary nodal recurrencein carcinoma breast after complete axillary clearance?
a. >20%
b. 0%
c. 2-4%
d. >50%

12. Amongst patients presenting with Internal mammary LNs, what is the most common location of IMC LNs?
a. First five intercostal spaces
b. 4 th and 5^{th} intercostal spaces
c. There is no such pattern
d. First three intercostal spaces

13. Which subtype of breast cancer has highest chances of local failure?
a. HER 2 Neu Rich type
b. Triple negative
c. Luminal Type A
d. There is no such predilection

14. What are the advantages of loco regional radiation therapy after mastectomy?
a. Reduction in local recurrence rates with improvement in overall survival
b. Reduction in local recurrence rate
c. Reduction in local recurrence without any impact on overall survival
d. Improvement in PFS

15. What is the most common location of local failure after mastectomy?
a. Pectotralis muscle
b. Intercostal muscles
c. Skin and subcutaneous space
d. Ribs

16. Who is not a candidate for APBI (Accelerated Partial Breast Radiation)?
a. Patient >50 Years age
b. Patient with nodal positive disease
c. Patient with low grade small DCIS
d. Patients with clear resected margins

17. Why should one keep dose to contralateral lung low in breast cancer RT?
a. To decrease incidence of pneumonitis
b. To decrease incidence of radiation induced second primary cancer
c. To spare contralateral lung of any side effects of RT
d. All of the above

18. Boost is beneficial for which breast cancer patients after BCS?
a. Patients less than 50 years age
b. Patients more than 70 Years of age
c. Patients with primary tumour<2 cm in size
d. Patients with primary tumour> 2cm in size

19. Which drug should not be combined concurrent with RT for breast cancer?
a. CDK 4-6 inhibitors
b. Aromatase inhibitors
c. Anti HER 2 Neu therapy
d. All of the above

20. Which subtype of breast cancer has highest chances of brain metastases?
a. Luminal Type A
b. Luminal type B
c. Triple Negative breast cancers
d. HER 2 Neu positive breast cancers

21. Which subtype of breast cancer has highest chances of leptomeningeal metastases?
a. Luminal Type A
b. Luminal type B
c. Triple Negative breast cancers
d. HER 2 Neu positive breast cancers

22. Which is the correct definition of EIC (ExtensiveIntradutcal Carcinoma)?
a. Presence of >90% intraductal neoplasia in invasive breast cancer
b. Presence of >75% intraductal neoplasia in invasive breast cancer
c. Presence of >50% intraductal neoplasia in invasive breast cancer
d. Presence of >25% intraductal neoplasia in invasive breast cancer

23. Which is not a sign of Inflammatory breast cancer?
a. Affected breast feeling warmer and heavier than the other
b. Edema of breast skin
c. Redness involving more than one third of the breast
d. Large palpable axillary nodal mass

24. What constitutes T4 disease in TNM staging of breast cancer?
a. >10 cm sized primary tumour
b. Tumour of any size with nipple retraction
c. Tumour with invasion of sternum
d. Tumour with invasion of skin or chest wall

25. What is N3disease in TNM staging of breast cancer?
a. $\geq$10 positive axillary Lymph nodes
b. Presence of axillary and internal mammary LN
c. Presence of supraclavicular lymph nodes
d. All of the above

26. Which second malignancies are common after breast cancer radiation therapy?

a. Lymphoma
b. Chest wall sarcoma
c. Meningioma
d. Ewing's sarcoma

27. Which IHC marker is specific for breast cancer diagnosis?
a. Estrogen Progesterone receptor
b. GATA 3
c. TTF-1
d. HER 2 Neu

28. As per ASTRO guidelines 2018, who is not a candidate for hypofractionated radiation therapy?
a. Patients older than 70 years age
b. Patients with triple negative breast cancer
c. Patients with DCIS post breast conserving surgery
d. Patients who are candidates for regional lymph node RT

29. Why hypofractionated radiation therapy (HFRT)is superior to Conventional fractionated RT?
a. HFRT is more safer for all normal organs
b. HFRT provides higher disease control
c. It saves resources and radiation machine time
d. HFRT is associated with better overall survival

30. Which patients with left breast cancer are not candidates for breath holding based radiation therapy?
a. Patients with internal mammary lymph nodes
b. Patients with favourable cardiac anatomy
c. Patients with mastectomy
d. Patients requiring regional nodal radiation

THIS QUIZ IS OPEN FOR RESIDENTS UPTO 3 YEARS OF POST PG EXPERIENCE

PLEASE MAIL YOUR ANSWERS TO dr.gautamsharan@gmail.com

Swear By Your Heart!

Dr Ritika Harjani Hinduja,
P. D. Hinduja National Hospital, Mumbai

From two tangents set up manually, using a wire to trace on a simulation sheet and using a protractor to determine treatment angles, which without any doubt gave great results, we have come a long way. The first step was to evolve to a CT based planning method. And from there it began! More information is definitely empowering but it also uncovers our lacunae and opens up scope for improvement.

Radiation therapy for left sided breast cancer leads to inevitable dose to cardiac tissues due to its anatomic proximity. With availability of documented heart doses with CT based planning, literature evolved about cardiac morbidity being associated with dose to heart. A population-based analysis of radiation-induced cardiac toxicity following treatment of left sided breast cancer suggested a 7.4% relative increase in major coronary events per 1 Gy increase in mean heart dose1. Thus, it is imperative for us, radiation oncologists to attempt to reduce the radiation dose to heart.

With this thought, various tele- RT techniques matured. They can be broadly categorized into three main categories, namely

- Motion management- deep inspiratory breath hold
- Prone treatment
- Conformal Intensity modulated treatments- IMRT, VMAT

Deep Inspiratory breath hold technique

Deep inspiratory breath hold technique in radiation therapy is a very useful innovation. When the patient takes a deep breath, there is expansion of the chest wall and a gap is created between the heart and the treatment area (breast or chest wall) thus minimizing exposure to heart (Figure 1).

There is ample literature to back the use of DIBH technique for delivering radiation to left breast cancers to minimize dose to heart. In a dosimetric study by Sripathi LK et al, DIBH treatment with 3DCRT planning decreased the Heart Dmean by 53.5% (7.1 vs. 3.3 Gy) and mean dose to LAD by 28% compared to free breathing scan and 3DCRT planning2. In another study conducted in Australia by Hayden and his colleagues; compared with FB, DIBH resulted in a significant reduction in heart V30Gy and mean heart dose, while no significant difference was noted for lung V20Gy, mean lung dose or mean dose to the contralateral breast3.

In our department at P. D. Hinduja National Hospital, we use the Real-time Position Management (RPM) (Varian Medical Systems, Inc, Palo Alto, CA) for DIBH treatments. We treat all left sided breast and indicated right breast carcinoma patients with DIBH (deep inspiratory breath hold) technique. We have an experience of treating425 patients with DIBH.

Analyses of dosimetriccomparison of free breathing and DIBH plans of consecutive patients of left breast cancer treated in our department also revealed a significant reduction in the mean heart dose and volume receiving 30Gy (V30Gy) with DIBH technique. Our results are consistent with the available literature.

Process in the clinic: When a patient with left breast cancer is seen in the clinic, she is assessed clinically for her breathing and based on clinical judgement for need,adviseda practice session on the simulator. During simulation, patient is positioned on an inclined breast board. The in-room infrared camera is adjustedto adequately view the infrared marker placed on the xiphisternum(Figures2,3). After adequate instructions and practice breaths with audio instructionsthrough an in-built mic, free breathing and DIBH image sets are acquired.

Swear by your heart-IMAGES

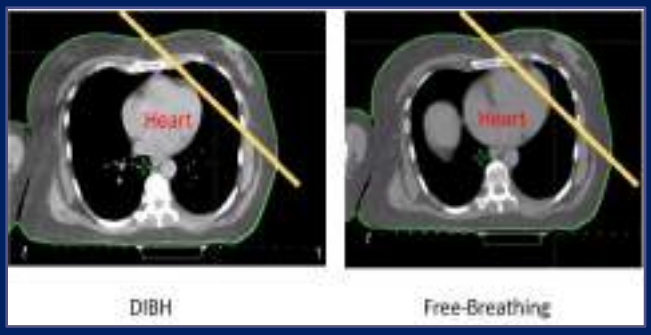

Figure 1: Shift in position of heart out of tangents with deep inspiratory breath hold

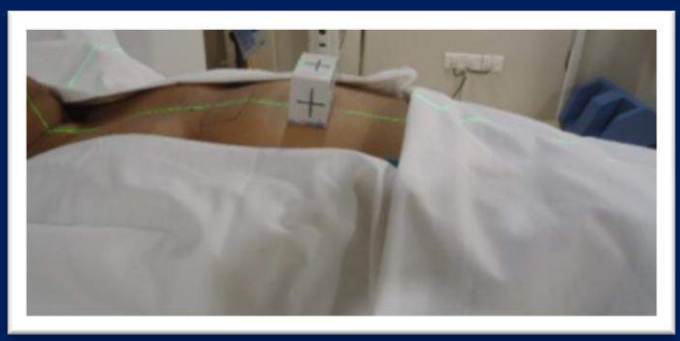

Figure 2- Infrared marker placed on patients' chest (near xiphisternum)

Figure 3: Infrared camera mounted in CT simulation room

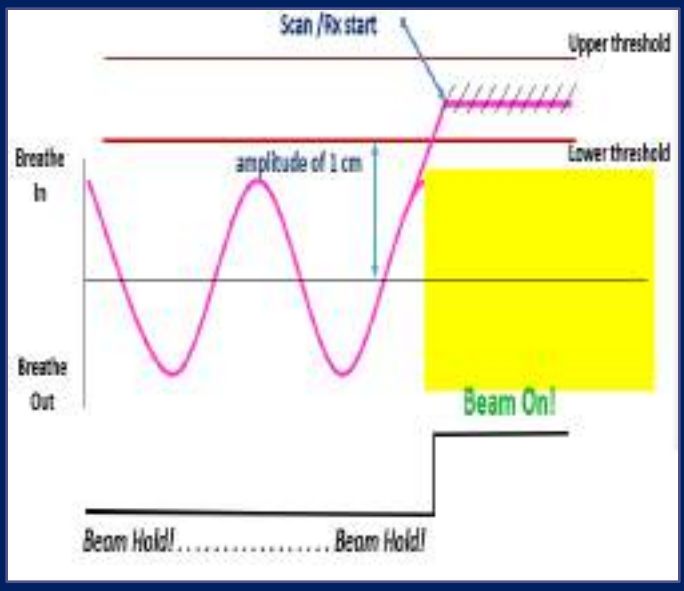

Figure 4: Pictural representation of the respiratory trace visible in CT and Linac console

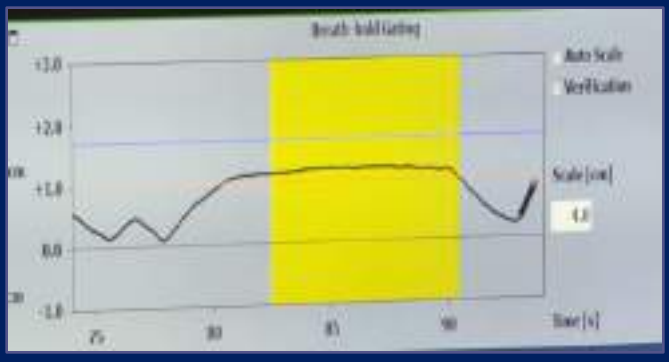

Figure 5: Patients' console respiratory trace image, Yellow colour indicates radiation beam

Figure 6: Qfix Access 360 prone breast board with hollow for breast

Figure 7: Patient positioned in prone position

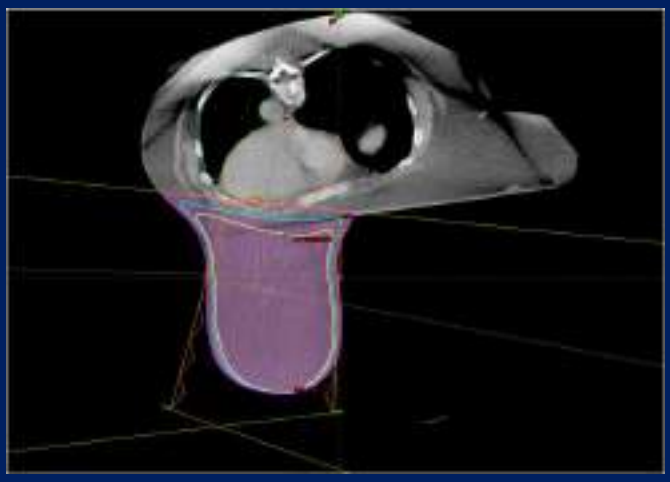

Figure 8: Planning CT image, showing dose distribution and beam angles

Figure 9: CT scan showing pushing away of heart and lungs from the treatment fields in prone position

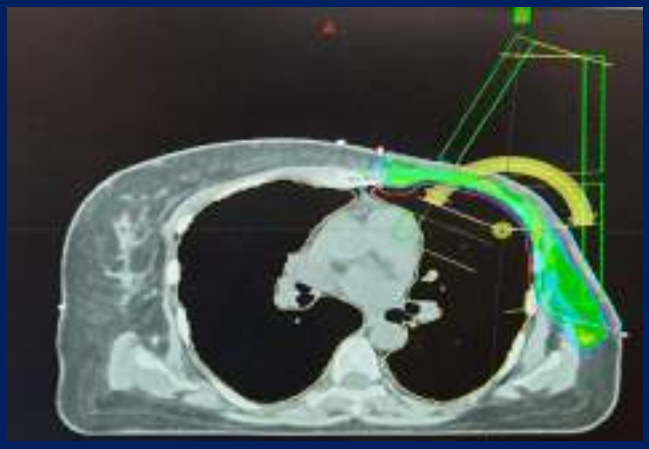

Figure 10: Partial arcs and dose distribution with VMAT planning while treating left sided chest wall

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Segmentation and planning are done as per standard guidelines. 3DCRT planning is most commonly employed. During delivery in the treatment room, the patient position and infrared marker position are replicated. The patient is instructed to take a deep breath and hold. When the breathing trace (amplitude) as acquired by the infra-red marker is within the designated threshold, radiation beam automatically switches on and delivers treatment (Figures 4, 5). If the patient starts to gradually breath out (detected by a fall in amplitude) or has abrupt breathing due to a bout of cough, the machine automatically stops its treatment.

While an amplitude of 1 cm is universally considered ideal and also used as cut-off for using DIBH in some centres, our departmental analyses has shown that there was no correlation identified between DIBH amplitude and reduction in any of the tested heart dose parameters. The patient with maximum DIBH amplitude in the study (1.9cms) was associated with 48% reduction in mean heart dose, while a patient with DIBH amplitude of less than 1 cms (0.9) had percentage reduction of 57.4 (more reduction than for the patient with amplitude 1.9cms). Simultaneously, another patient with amplitude 0.9cm had only a dose reduction by 32.3%. While most existing studies have failed to demonstrate a correlation between DIBH amplitude and magnitude of heart dose reduction, a study by Ledsom et al4performed-on patients at Clatter bridge hospital has shown a positive correlation.

In the same analyses, we have tried to predict magnitude of heart dose reduction using various existing physical parameters like DIBH amplitude, some under-researched parameters like anterior sternal displacement and some novel parameters like diaphragmatic displacement and volume of lung ratios. Our results are encouraging (in process of publication).These predictors in unison may be used to construct a model to predict the magnitude of benefit in reducing heart dose with DIBH.

Prone treatment for carcinoma breast

Treatments for large pendulous breasts involve technical limitations which compromise on dose homogeneity. Attempts to improve homogeneity included mixing beam energies, introducing immobilization devices and altering patient position. Lateral decubitus position is one such position used that is effective in decreasing the separation by reducing breast thickness. However, the major limitation is difficulty in reproducing the daily set up.

Work on prone breast treatments began in early 1990s and various institutes like Memorial Sloan-Kettering Cancer Centre, University of South California and New York University, amongst others performed initial research and developed their indigenous prone breast boards. Early reports suggested that more homogeneous isodose distributions were found for the patients in the prone position when compared with supine position.

We have a dedicated prone breast board, namely Access 360 by Qfix medical devices at our department. Women with pendulous breasts are treated in prone position. The prone board has an opening for the breast for executing treatment(Figures6,7). It has prone headrests and handrests for comfortable patient positioning. They also have a mesh superior to the breast hollow to facilitate supraclavicular irradiation. Two lateral beams/ oblique beams are used for planning (Figure 8). Prone positioning along with two lateral/ oblique beams drastically minimizes the extent of heart and lung in the radiation field (Figure 9). We also treat some patients of breast carcinoma with pendulous breasts in lateral decubitus position in our department

In one of our institutional studies, we compared treatment plans for 12 patients simulated both on the Access 360 prone breast board and in supine position using DIBH technique. The mean heart dose was marginally decreased (not statistically different) with prone planning as compared to DIBH, but there was a dramatic reduction in lung doses, mean ipsilateral lung dose (9.4Gy vs 1.7Gy) and V20Gy (16.3% vs 1.3%).

The treatment time was increased while treating in prone position and there were no differences in systematic and random errors during treatment (presented at ASTRO, 2018).

Intensity modulated treatments

Breast planning with VMAT has been traditionally explored, especially for left breast cancers for same primary purpose of decreasing heart doses and improving target dose homogeneity. For patients with unfavourable anatomy, commonly chest wall, where dose to heart remains high despite using DIBH technique or in locally advanced mastectomy or breast conservation treated patients where treatment to the internal mammary chain of lymph nodes is indicated, we perform VMAT treatment. Commonly two to four partial arcsare used for planning (Figure 10). It is our practice to always use VMAT technique coupled with DIBH as the planning with an anterior skin flash to account for the breathing motion in an otherwise highly conformal distribution accounts to planning uncertainties. In patients where DIBH is not feasible, an anterior flash is used.

In a departmental study, we compared IMRT and 3DCRT plans done on free breathing image sets and compared with DIBH and 3DCRT planning. With comparable PTV coverage, we found that mean heart dose reduced with DIBH planning by 28.6% while compared to IMRT planning and by 47.7% when compared with 3DCRT planning (presented at AMPICON 2016). However, we are yet to analyse our outcomes comparing IMRT/VMAT on DIBH image set compared to other modalities.

In conclusion,

we have evolved from 2D planning to newer technological advancements and each technique is indicated in particular circumstances. We at P. D Hinduja have experience in treating with DIBH, in prone position, in lateral decubitus position and using VMAT technique. Patient selection is key and a sound knowledge accompanied with experience is vital to deliver quality treatment.

Acknowledgements: I would like to sincerely thank Dr V Kannan for the guidance and the entire department of Radiation Oncology at P. D. Hinduja hospital where I have gained maximum experience in all techniques used for breast carcinoma treatment.

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Indian College of Radiation Oncology (ICRO)

Academic Wing of

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PROADVANCE 2021

TRENDING UPDATES IN RADIATION ONCOLOGY WEBINAR SERIES

24th - 26th November 2021,
5:30 PM-8:00 PM

Webinar Link-

https://webstream.streamcart.com/live/sunicroprodvance2021

Association of Radiation Oncologists of India (AROI) has always focused on being at the forefront of academic and research activities in radiation oncology all across the country, covering all aspects of radiotherapeutic management. Radiotherapy has witnessed markedly rapid progress in cancer care. Present day radiation techniques aim to reduce the complications and increase tumor control. Stereotactic radiotherapy has made it possible to deliver radiotherapy without any major side effects. PRODVANCE is a career oriented initiative for young radiation oncologists, organized by Indian College of Radiation Oncology (ICRO), academic wing of Association of Radiation Oncologists India (AROI), which is organized every year at Zonal level. This programme will be organised by the AROI and ICRO itself through the webinar series. Trainees in the subject and radiation oncologists with less than 10 years of experience are encouraged to register (Latest by 21st November 2021). Kindly register early so that you will not miss this webinar.

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PART 1 - NOVEMBER 24TH 2021, WEDNESDAY

Webinar Coordinator for Part 1

Dr. V. Srinivasan,
HOD-Radiation Oncology,
MIOT International, Chennai

Time	Topic	Speaker
	TECHNOLOGICAL UPDATES	
05.30 pm-06.00 pm	FLASH Therapy – Physics, Biology, Clinical implications and Future (25mins) (5mins Q & A)	**Dr. Durgapoorna,** ASTER Medicity, Kochi
06.00 pm-06.30 pm	Recent technological advancements in the linear accelerator (including MR Linac) (25mins) (5mins Q & A)	**Dr. Shikha Goyal,** PGI, Chandigarh
06.30 pm-07.00 pm	Role of Surface Guided Radiation Therapy – Rationale and clinical implications (25mins) (5mins Q & A)	**Dr. Prasad Raj Dandekar,** Sri HN Reliance Foundation, Mumbai.
07.00 pm-07.30 pm	Artificial intelligence in segmentation and planning! Are we there yet? (25mins) (5mins Q & A)	**Dr. Santam Chakraborty,** TMC, Kolkata.
07.30 pm-08.00 pm	Radiogenomic integration in Radiation therapy and its impact – Review of evidence in Medulloblastoma (25mins) (5mins Q & A)	**Dr. Rimpa Achari,** TMC Kolkata.
08.00 pm	**LOGOUT**	

AROI ICRO - PRODVANCE 2021,
TRENDING UPDATES IN RADIATION ONCOLOGY – WEBINAR SERIES
PART 2 - NOVEMBER 25TH 2021, THURSDAY

Webinar Coordinator for Part 2

Dr. Pooja Nandwani Patel,
Sterling Cancer Hospital,
Ahmedabad

Time	Topic	Speaker
	PRACTICE CHANGING UPDATES	
05.30 pm-06.00 pm	FAST Forward – A way ahead in Breast irradiation (25mins) (5mins Q & A)	**Dr. Rima Pathak,** TMH, Mumbai.
06.00 pm-06.30 pm	Role of HPV and De-escalation – Do we have enough evidence to change? (25mins) (5mins Q & A)	**Dr. Cessal Kainickal,** RCC, Trivandrum
06.30 pm-07.00 pm	POP-ART, CHHiP and STAMPEDE – Where do we stand in Prostate Radiation (25mins) (5mins Q & A)	**Dr. Gagan Saini,** Max-Vaishali & Patparganj, Delhi
07.00 pm-07.30 pm	Organ Preservation in Rectal Cancer – Review of recent evidence to wait and watch (25mins) (5mins Q & A)	**Dr. Ajeet Kumar Gandhi,** RMLIMS, Lucknow
07.30 pm-08.00 pm	Every Gray counts – Moving from IFRT to ISRT in Lymphoma (25mins) (5mins Q & A)	**Dr. Patricia Sebastian,** CMC, Vellore
08.00 pm	**LOGOUT**	

AROI ICRO - PRODVANCE 2021,
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PART 3 - NOVEMBER 26TH 2021, FRIDAY

Webinar Coordinator for Part 3

Dr. Gautam .K. Sharan,
Consultant Radiation Oncologist,
Jawaharlal Nehru Cancer Hospital, Bhopal

Time	Topic	Speaker
	CLINICAL RESEARCH UPATES	
05.30 pm-06.00 pm	CATNON and CODEL – update in management of anaplastic Glioma and Oligodendroglioma (25mins) (5mins Q & A)	**Dr. Rahul Krishnatry,** TMH, Mumbai.
06.00 pm-06.30 pm	PORTEC 3 – Wise decisions in molecular profiling (25mins) (5mins Q & A)	**Dr. Shradda Raj,** IGIMS, Patna.
06.30 pm-07.00 pm	ICRU 89: Time to move beyond Point A? – update in CT Adaptation for Brachytherapy (25mins) (5mins Q & A)	**Dr.Susovan Banerjee,** Medanta The Medicity, Gurgaon.
07.00 pm-07.30 pm	Early Lung and Oligometastatic Lung Cancer – Trending updates provide a new opportunity (25mins) (5mins Q & A)	**Dr. Srinivas Chilukuri,** Apollo Proton CC, Chennai.
07.30 pm-08.00 pm	PARCER Trial – An opportunity to improve the toxicity in cervical malignancies (25mins) (5mins Q & A)	**Dr. Supriya Sastri,** TMH, Mumbai.
07.30 pm-08.00 pm	**ICRO PRODVANCE QUIZ**	
08.00 pm	**LOGOUT**	

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