

6TH ANNUAL CONFERENCE OF INDIAN BRACHYTHERAPY SOCIETY 2016 (IBSCON 2016) PROCEEDINGS

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on behalf of Indian Brachytherapy Society



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The 6th Annual Conference of Indian Brachytherapy Society (IBS) 2016 (IBSCON 2016) was conducted by the Radiation Oncology Division of Dr. Kamakshi Memorial Hospital, Chennai, and Indian Brachytherapy Society in collaboration with Association of Radiation Oncologists of India – Tamil Nadu and Pondicherry Chapter (AROI – TN & PY) at Chennai from 26th to 28th August 2016. The theme of the conference was **“Brachytherapy – an Immortal Art”**.

The pre-conference workshop (26th August 2016) was conducted at Cancer Institute (WIA), Adyar, Chennai. The workshop included live hands-on demonstration of interstitial brachytherapy procedures for oropharyngeal cancer (base of tongue), and intra-operative brachytherapy for soft tissue sarcoma of gluteal region. The procedures were performed by the national experts in the operating room and beamed live to the hall. The entire procedure, imaging, principles of planning, plan evaluation, and tips & tricks were explained to the delegates. The workshop was attended by approximately 250 delegates.

The next two days (27th and 28th August 2016) of the conference was held at Hyatt Regency, Chennai, India. These 2 days were dedicated to new horizons in brachytherapy including brachy-physics, radiobiology, clinical research, clinical outcome, and ongoing research. The conference was attended by 300 delegates, which has been the largest meeting ever for the IBS. The scientific programme was an academic feast to all the delegates as we had an incredible gathering of renowned National and International faculties sharing their brachytherapy experiences. Professor Richard Pötter from Medical University Vienna, known for his pioneering research and exemplary contribution in the field of ‘image guided brachytherapy’, delivered the ‘key note address’. During the inaugural ceremony, a brachytherapy specialists section of IBS and the new IBS website was inaugurated. Apart from invited scientific deliberations, best paper, proffered papers, and posters were discussed. The details of various sessions are as shown in the scientific program. The highlights of the 1st day included recent advances in brachytherapy sources, need for quality assurance programs, radiobiology of HDR brachytherapy, key note address, GYN brachy session with introduction of ICRU 89, Indian experience of IGABT, recent advances in treatment of endometrial cancer, breast brachytherapy advances, especially APBI and its current status, brachytherapy in ophthalmic tumors and pediatric tumors, and an interesting debate on robotic surgery versus brachytherapy in prostate cancers. The 1st day was concluded by the general assembly of the IBS. The 2nd day conference included the best paper presentations, poster discussions, head and neck brachytherapy update on nasopharyngeal cancer experience in India, salvage brachytherapy options and ongoing research studies, and other brachytherapy accessible sites including esophageal, endo-bronchial and endo-biliary cancers. During the conference, around 36 selected abstracts were discussed about best paper, proffered paper, and poster discussion sessions.

Indian Brachytherapy Society would like to acknowledge Radiation Oncology Division of Dr. Kamakshi Memorial Hospital, Chennai and Association of Radiation Oncologists’ of India – Tamil Nadu and Pondicherry Chapter (AROI – TN & PY) for hosting the 6th Annual Conference of IBS 2016 (IBSCON 2016). IBS would also sincerely thank the gold, silver, and bronze sponsors Elekta, Varian, and Bebig, respectively, and other sponsors for their generous contribution towards Annual IBS activities 2016 including the IBSCON 2016. Finally, IBS would like to thank the national faculty, all the IBS members, office bearers, and others for their contribution in making IBSCON 2016 Conference a big success!

6th Annual Conference of Indian Brachytherapy Society IBSCON 2016

(26th to 28th August)

In collaboration with AROI (TN & PY chapter)
Pre-conference workshop: 26th August 2016, Friday
Venue: Cancer Institute (WIA), Adyar, Chennai

| | |
|------------------|---|
| 9:00-9:05 a.m. | Welcome address by Dr. G. Selvaluxmy |
| 9:05-9:30 a.m. | Inauguration of the workshop by Dr. V. Shanta, Dr. G. Selvaluxmy, Dr. B. Selvamani, Dr. R.L. Bhalavat, Dr. U. Mahantshetty, Dr. V. Srinivasan |
| 9:30-9:45 a.m. | Overview including objective of the workshop by Dr. G. Selvaluxmy |
| 9:45-10:00 a.m. | I case introduction – oropharynx (base of tongue) by Dr. A. John |
| 10:00-10:30 a.m. | Oropharynx brachytherapy – procedure outline by Dr. N. Syed |
| 10:30-12:30 p.m. | Live demonstration – head & neck From OT: Dr. R.L. Bhalavat, Dr. A. John, Dr. K. Gunaseelan, Dr. H. Kumar From floor: Dr. K.S. Kirushna Kumar, Dr. A. Mukerjee, Dr. A.A. Prasad |
| 12:30-1:00 p.m. | Planning outline by physics team H&N (Dr. Vivekanandan & Dr. A. Murugan) |
| 1:00-1:45 p.m. | Lunch break |
| 1:45-2:00 p.m. | II case – soft tissue sarcoma – intraoperative brachytherapy |
| 2:00-2:15 p.m. | Soft tissue sarcoma implant – procedure outline by Dr. M. Chandra |
| 2:15-2:30 p.m. | Brachytherapy planning principles by Dr. T. Naveen |
| 2:30-4:00 p.m. | Live demonstration – soft tissue sarcoma From OT: Dr. S. Laskar, Dr. D. Saritha, Dr. V. Balasundaram From floor: Dr. R. Rathnadevi, Dr. B. Subathira, Dr. J. Surendran |
| 4:00-4:45 p.m. | Brachytherapy planning – STS case demo (SV Jamema & Ms. X. Sidonia Valas) |
| 4:45-5:00 p.m. | Sum up |
| 7:00 p.m. | IBS Executive Committee meeting at Grand Hyatt |

Theme: "BRACHYTHERAPY – AN IMMORTAL ART"**Venue: Hyatt Regency, Chennai****DAY 1: 27th August 2016, Saturday**

- 8:30 a.m.** Registration desk opens
- 9:00-9:10 a.m.** Welcome address by Organizing Secretary
- 9:10-10:10 a.m.** **Brachytherapy physics and radiobiology session (20 minutes each)**
Chairpersons: Prof. A. Vasanthan, Dr. A.N. Vaithyshwaran
 1. Newer brachytherapy sources: Prof. Thayalan
 2. QA program for brachytherapy: Dr. S.V. Jamema
 3. Radiobiology of HDR brachytherapy: Dr. M. Gupta
- 10:10-10:40 a.m.** **Proffered papers (4 papers: 8 minutes + 2 minutes discussion)**
Chairpersons: Dr. A.A. Prasad, Dr. S. Laskar
- 10:40-11:00 a.m.** **Tea break**
- 11:00-11:30 a.m.** **Inauguration of the Conference**
- 11:30-12:15 p.m.**
Chairpersons: Dr. R. Bhalavat, Dr. U. Mahantshetty (IBS President and Secretary)
Key note address: Prof. R. Pötter
- 12:15-1:15 p.m.** **GYN session – recent concepts & evidence (15 minutes each)**
Chairpersons: Dr. G. Amarnath, Prof. J. Subashini
 1. Transition from 2D to 3D Brachytherapy in cervical cancer: Dr. U. Mahantshetty
 2. GEC-ESTRO ICRU concepts: Prof. R. Pötter
 3. Optimizing radiation therapy for early endometrial cancer – with special emphasis on BT:
 Dr. D.N. Sharma
 4. Better local control and no proctitis with improvised technique of brachytherapy:
 Dr. M. Chandra
- 1:15-2:00 p.m.** **Lunch. VIDEO presentation: GYN: Prof. R. Pötter/U. Mahantshetty**
- 2:00-2:40 p.m.** **Advances in breast brachytherapy (20 minutes each)**
Chairpersons: Dr. S. Krishnan, Dr. S.P. Kumar
 1. Target definition and selection criteria for Breast BT: Dr. K. Gunaseelan
 2. Evidence for APBI – local control, toxicities, and cosmetic outcomes: Dr. R. Subramaniam
- 2:40-3:25 p.m.** **Miscellaneous (15 minutes each)**
Chairpersons: Dr. S. Vijayaraghavan, Dr. M. Balu David
 1. Brachytherapy in ophthalmic tumors: Dr. V.P. Reddy
 2. Brachytherapy in pediatric tumors: Dr. S. Laskar
 3. HDR brachytherapy in rectal and anal canal cancers: Dr. T. Ram
- 3:25-3:50 p.m.** **Vendor presentation/discussion**
 1. ELEKTA: 10 minutes (8 minutes + 2 minutes discussion)
 2. VARIAN: 7 minutes (5 minutes + 2 minutes discussion)
 3. BEBIG: 5 minutes
- 3:50-4:10 p.m.** **Tea break**

- 4:10-5:00 p.m. Prostate HDR brachytherapy (15 minutes each)**
Chairpersons: Dr. S. Chandrasekar, Dr. L. Padmanabhan
 1. Monotherapy in intermediate and high risk disease: Dr. S. Pavamani
 2. Salvage re-irradiation with HDR BT: Dr. P. Mahadev
 3. Debate: Robotic surgery vs. brachytherapy in early prostate cancers
Moderator: Dr. K.S. Kirushna Kumar
 - In favor of HDR Brachy: Dr. V.J. Anand (7 minutes)
 - In favor of robotic surgery: Dr. A. Sivaraman (Uro Oncologist) (7 minutes)
 Rebuttal: Total 5 minutes (2.5 minutes each)
- 5:00-6:00 p.m. Proffered papers (6 papers: 8 minutes +2 minutes discussion)**
Chairpersons: Dr. Vidhya, Dr. A. John
- 6:00-7:00 p.m.** Annual General Body Meeting – For IBS Members only
- 7:30 p.m. onwards** Dinner

DAY 2: 28th August 2016, Sunday

- 9:00-10:10 a.m.** Best paper (4 papers: 40 minutes) and poster discussion (30 minutes)
Chairpersons: Dr. V. Srinivasan, Dr. P. Nandwani Patel
- 10:10-10:30 a.m.** Tea break
- 10:30-11:50 a.m. Head and neck brachytherapy (20 minutes each)**
Chairpersons: Dr. J. Stumpf, Dr. R. Bilimagga
 1. Brachytherapy in naso-pharyngeal cancers: Dr. A. Mukherjee
 2. Salvage brachytherapy: Dr. R.L. Bhalavat
 3. EBRT and brachytherapy boost in head & neck cancers – recent evidence: Dr. A. Budrukkar
 4. Ongoing studies and potential research avenues: Dr. Koushik
- 11:50-12:50 p.m. Accessible sites session (20 minutes each)**
Chairpersons: Dr. S. Saravanan, Dr. S. Saha
 1. Intraluminal HDR BT for esophageal cancers: Dr. K. Sateesh Babu
 2. Endobronchial brachytherapy: Dr. P. Nandwani Patel
 3. Mould brachytherapy – JIPMER experience: Dr. A. Mukherjee
- 12:50-1:00 p.m.** Wrap up
- 1:00-1:15 p.m.** Valedictory function
- 1:15 p.m. onwards** Lunch

Abstracts

A. Best Paper Award Session

[1]

Long term results and late toxicity in endometrial adenocarcinoma patients treated with radiotherapy: seven-year results from a single institution

Prahlad H. Yathiraj, Uday Kumar P., Krishna Sharan, Anshul Singh, Anusha Reddy, Donald Fernandes, Vidyasagar M.S.

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Purpose: To report the incidence, severity, and time of onset of late toxicities in patients of endometrial adenocarcinoma (EA) treated with external beam radiotherapy (EBRT) + brachytherapy (BT), or vaginal brachytherapy (VBT) alone.

Material and methods: Archives of a single institution from 2008-2015 were studied. The indications for EBRT and VBT were based on standard recommendations. EBRT was planned to 50 Gy/25 fractions/5 weeks/3D-CRT with 4-field 'box' technique on a dual energy linear accelerator. VBT was planned using appropriate vaginal cylinder treating upper half of vaginal cuff, prescribed 5 mm from vaginal surface using Ir-192 micro-Selectron to doses of 4 Gy x 4 fractions/4 days or 6 Gy x 5 fractions/7 days with or without EBRT, respectively. Intra-cavitary BT (ICBT) was prescribed to point A to 7 Gy x 3 fractions once weekly. Survival was calculated from Kaplan-Meier curves, and toxicity was recorded using CTCAE V3.

Results: Of 120 patients registered, 19 were excluded due to inadequate follow-up. Among the 63 patients who received RT, 18 received VBT alone and 40 received adjuvant EBRT + VBT. Five patients received definitive EBRT + ICBT, all of whom are disease free with median follow-up of 36.5 (range: 18-76) months. With median follow-up of 30 (range: 0.8-81) months, median DFS and OS were 79.2% and 75.7%, respectively in the adjuvant RT setting. Cystitis, proctitis, and enteritis was reported in 7% (all grade I/II), 17% (9% grade I/II and 8% grade III), and 5% (all grade I/II), respectively. All toxicities were seen in the EBRT arm. EBRT resulted in significantly higher proctitis than VBT alone ($p = 0.02$). The median time to cystitis, proctitis, and enteritis were 27, 17, and 28 months, respectively.

Conclusion: With the use of 3D-CRT in endometrial adenocarcinoma, late toxicity rates appear low and mild, however EBRT leads to significantly higher proctitis than VBT alone.

[2]

Evaluation of apparent diffusion coefficient (ADC) in image guided adaptive brachytherapy (IGABT) for cervical cancer

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Purpose: T2 weighted MRI is recommended for IG-ABT in cervical cancer. HRCTV (volume for optimization) contains suspicious grey zones that are contoured subjectively on case to case basis. Whether these zones contain macroscopic residual, the disease is unknown. DWI and the derived ADC are functional imaging that may add additional biological information on these grey zones. The objectives were: 1. To investigate the presence or absence of abnormal ADC outside the HRCTV contours as defined by GEC ESTRO; 2. To objectively define the extent of HRCTV contours in the suspicious grey zones with the help of ADC derived from diffusion weighted imaging (DWI).

Material and methods: 30 patients with biopsy proven squamous cell carcinoma of cervix were included. These 30 patients were divided into 3 groups of 10 selectively chosen patients, based on commonly experienced clinical scenario: 1st group: large parametrial disease and near complete response post EBRT; 2nd group: large parametria poor response; 3rd group: no parametria and near complete response. All patients underwent a diagnostic MRI of abdomen and pelvis along with DWI. ADC maps were derived using three levels of b values 0, 600, 1000 s/mm² from DWI ADC for the following regions were calculated. Tumor, tumor edge, 1 cm lateral to tumor edge and 5 mm medial to obturator internus in the parametrial region. Post EBRT MRI was taken after the 1st application of brachytherapy along with DWI and ADC was derived; HRCTV was contoured using GEC ESTRO guidelines on T2W para axial images, and fused with DWI and ADC images. ADC was again calculated for the same areas (as mentioned earlier) on the brachytherapy MRI with respect to the HRCTV contours, and it was investigated whether the abnormal ADC lies inside or outside the contours.

Results and conclusion: Discussed during the Conference.

[3] Single institute experience of high dose rate interstitial brachytherapy for head and neck malignancies with curative intent and use of angio-catheters as carriers of Iridium - 192 implants

Pareek Vibhay, Bhalavat Rajendra, Chandra Manish, Nellore Lalitha, Bauskar Pratibha, George Karishma, Borade Dipalee, Kalariya Ketan, Moosa Zaiba, Nanda Kumar

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Purpose: To evaluate the treatment outcomes with HDR interstitial brachytherapy in head and neck cancers at our Institute with use of angio-catheters as carrier source of Iridium-192 wire implants, a retrospective analysis was carried out.

Material and methods: 58 patients with head and neck malignancies of varying TNM staging as per AJCC staging criteria were analyzed retrospectively between 2008 and 2015. 42 patients (72.41%) received EBRT with HDR-BT and 26 patients (27.59%) received BT alone. 23 patients (39.65%) received concurrent chemotherapy. The age group ranged from 27 to 81 years (median age: 56 years) with 41 patients (70.69%) males and 17 patients (29.31%) females. HDR-BT was delivered with Iridium-192 wire implants using plastic bead techniques with varying dose rates. The biological equivalent doses (BED) were calculated for both BT and EBRT keeping $\alpha/\beta = 10$ for tumor and $\alpha/\beta = 3$ for normal tissue and subsequently median BED doses were calculated; similarly, 2 Gy equivalent dose (EQD₂) were calculated and loco-regional control and disease free survival was assessed.

Results: After completion of HDR-BT, patients were followed-up one month later and subsequently every 3 months for first 2 years and thereafter every 6 months with median follow-up period of 25 months (range: 2-84 months). The DFS probability at year 1 was 82.76% and 68.05% at year 7. The overall survival probability was 91.37% at year 1 and 85.89% at year 5. The local control rate was 67.27% and control rates according to the stage of disease and T size classification are mentioned in Table 1. The rate of local recurrence was 8.62%, regional recurrence was 1.72%, loco-regional failure was 3.44%, and distant metastases following local or regional failure was 17.23%. The Median BED for $\alpha/\beta = 10$ was 86.775 Gy, and DFS was 74.07% in patients receiving more than 86.775 Gy; DFS was 64.82% in patients receiving less than 86.775 Gy and median BED for $\alpha/\beta = 3$ was 128.76 Gy; DFS was 74.07% in patients receiving more than 128.76 Gy as compared to 64.82% in patients receiving less than 128.76 Gy. The median EQD₂ for $\alpha/\beta = 10$ was 71.6 Gy, and for $\alpha/\beta = 3$ was 75.85 Gy. The DFS was 75.86% in patients receiving more than median dose of 71.6 Gy compared to 61.53% in those receiving less than the median dose. The DFS was 78.57% in patients receiving median dose of 75.85 Gy as compared to 59.26% in those receiving less than the median dose.

Conclusion: The overall outcome in patients with oral cavity and oropharyngeal malignancies was good with implementing of HDR - interstitial brachytherapy and use of angio-catheters as carriers of Iridium-192 wire. The BED₁₀ value of 86.775 Gy and BED₃ of 128.76 Gy showed that the dose received more than the median reported better outcomes in the form of DFS. The EQD₂ calculated values suggested the dose received more than 71.6 Gy ($\alpha/\beta = 10$) and 75.85 Gy ($\alpha/\beta = 3$) showed better outcomes. The role of HDR interstitial brachytherapy in head and neck cancers is a proven, effective, and safe treatment method with excellent long term outcome.

[4] Accelerated partial breast irradiation with interstitial brachytherapy - a single institute experience

Sasikala P., Bilimaga Ramesh S., Gopinath K.S., Punitha Ravind R.

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Purpose: Accelerated partial breast irradiation (APBI) is a rapidly evolving technique in the management of early breast carcinoma with favorable prognostic factors. With an aim to assess the local control and overall survival in early breast carcinoma treated with APBI.

Material and methods: 41 patients from 2007-2015 with early breast carcinoma treated in our tertiary cancer care center were included in this study. All patients underwent breast conservation surgery with axillary dissection followed by APBI using interstitial brachytherapy technique. Catheters were implanted in 2 planes superficial and deep with each catheter placed 1 cm apart. CT scan was done and CTV was contoured to include tumor cavity with 2 cm margins. CTV was edited 5 mm below the skin. Brachytherapy plans were approved as per ABS recommendations with > 90% of the target receiving 90% of the prescribed dose. V₁₅₀ < 70 cc, V₂₀₀ < 20 cc, and skin dose < 100%. Radiation was delivered with 34 Gy in 10 fractions with an interfractional interval of 6 hours, 2 fractions per day for 5 consecutive days.

Results: The median age of patients was 60 yrs., with T1 - 61% (25), T2 - 39% (16), luminal type A - 71% and type B - 29%. All patients had margin and node negative. The median follow-up period was 27 months (range: 12-90). 30 patients were disease free, 2 patients had local recurrence, and 9 patients were to lost follow-up. Kaplan-Meier test was used for survival analysis. The median overall survival was 31 months. None of the patient had acute skin toxicity and had good cosmesis results on long term follow-up.

Conclusion: APBI is a promising option for early breast carcinoma with favorable prognostic factor. In future, APBI shall be the gold standard for early breast carcinoma, since local recurrences occur more in and around the tumor cavity.

B. Preferred papers

[1]

Computed tomography based volumetric brachytherapy planning for cervical cancer: an early experience from a single institution

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Purpose: Brachytherapy is essential component in management of cervix carcinoma. Volumetric MR image based brachytherapy is the current standard of care. However, many centers do not have MRI or MR compatible applicators in our country. The aim of present study is to analyze the outcome of patients treated with computed tomography based brachytherapy planning. The objective of the present study is to assess local control, acute and chronic complications in patients treated with this technique.

Material and methods: All cases of cervix carcinoma treated with definitive radiotherapy from April 2013 till December 2015 were analyzed. Definitive radiotherapy included external beam radiotherapy (with concurrent platinum based chemotherapy) followed by brachytherapy. *Brachytherapy technique:* All patients underwent HDR brachytherapy on Cobalt-60 remote afterloading machine. Intracavitary or interstitial application was decided based on parametrial involvement and favorable anatomy. Two applications were done one week apart, 2 fractions of 7 Gy (HDR) were delivered to target volume in each application 4-6 hours apart. All patients underwent CT simulation for planning, the bladder, rectum, sigmoid, small bowel, and PTV (gross residual disease at the time of application) were contoured (Figure 1). 2 cc dose of bladder, rectum, and sigmoid was severely restricted to 85%, 65%, and 65% of the prescription dose. Acute complications, local control, and chronic toxicities were recorded and analyzed.

Results: 71 patients who fitted the inclusion criteria were included. The analysis involved 139 sessions of brachytherapy (59 intracavitary and 80 interstitial sessions). The mean 2 cc dose for bladder, rectum, and sigmoid were 76.1% (± 5.3), 58.4% (± 7.7), and 45.7% (± 13.7), respectively. The mean D_{90} of PTV was 84% (± 10.2). The local control at the end of 6 months was 93% and at 2 years was 86.4%. Five (6.9%) patients developed hemorrhagic radiation proctitis; one patient developed hemorrhagic cystitis.

Conclusion: CT based volumetric brachytherapy planning yields comparable outcomes with that of the MRI based volumetric planning techniques in Indian setup.

[2]

High dose rate intraluminal brachytherapy in esophagus carcinoma: toxicity, response, and survival

Prashanth Bhat Kainthaje, Pradeep Gaur, Anees Malavat, Rajan Paliwal, Shweta Mutha

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Purpose: Intraluminal brachytherapy (ILBT) is recommended in the treatment of esophagus carcinoma in definitive and palliative setting. ILBT offers an elegant path to deliver high doses to the primary tumor while mitigating the problem of high doses to surrounding organs at risk, especially the spinal cord, encountered with external beam radiotherapy (EBRT). With an aim to study the profile of patients of esophagus carcinoma treated with ILBT, the outcome of the treatment in terms of response assessment, toxicity, and survival were analyzed.

Material and methods: The study period was between January 2014 and June 2015, with 25 patients of esophagus carcinoma middle third, treated with ILBT either as part of definitive radiotherapy or as part of palliative radiotherapy. The patients with unifocal disease ≤ 10 cm in length and with no recorded intra-abdominal or distant metastases received definitive radiotherapy with 44 Gy/22 fractions through EBRT with concurrent cisplatin followed by, 10 Gy/2 fractions of ILBT boost once weekly. The patients with local advanced disease for palliation received 36 Gy/12 fractions through EBRT, followed by 10 Gy/2 fractions of ILBT once weekly. The outcome of the treatment was assessed in terms of dysphagia score, dysphagia free survival, toxicities, and overall survival.

Results: Median age of patients was 55 years. Histopathologically, 96% of patients had squamous cell carcinoma. 16 (64%) were treated with definitive radiotherapy while the rest, 9 (36%) with palliative intent. At a median follow-up of 9 months, 13 patients were dysphagia free and 5 deaths occurred. One month after completion of the treatment, 18 patients were dysphagia free, while two patients had partial relief, and 5 patients did not notice any relief in dysphagia. Two patients died within 6 months of completion, while 2 patients developed trachea-esophageal fistula during follow-up.

Conclusion: ILBT is a safe modality for boost in treatment of esophagus carcinoma, if the patients are selected with caution.

[3]
Does catheter entry-exit dosimetry correlate with a grade of post-implant skin marks after breast multicatheter interstitial brachytherapy (B-MIB)?

Revathy Krishnamurthy, Tabassum Wadasadawala, Umesh Gayake, Reena Phurailatpam, Siji Paul, Rajiv Sarin

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Purpose: The grade of post-implant skin marks after B-MIB is an important factor in determining cosmesis. This study intends to establish the correlation between catheter entry-exit dosimetry and the grade of skin marks at entry-exit sites.

Methods: Visibility and quality of entry and exit marks were noted plane-wise for 10 patients with minimum 18 months' follow-up post implant and graded as 'not visible', 'faint', 'clear', and 'prominent'. Catheters with entry-exit points closest to first/last dwell positions were selected from each plane of implant. Distance from first/last dwell position, dose, closest distances from CTV, and reference isodose (85%) were obtained for the selected catheters and correlated with implant mark grades given to corresponding plane using Spearman's co-efficient.

Results: With a mean age of 57.2 years (45-68) and mean follow-up of 31.9 months (18-49), intra-op implant was done in 5 out of 10 patients. Number of planes were 3 in 50%, 4 in 50%, and median number of needles implanted were 19 (16-22). Cosmesis was good or excellent in 7 out of 10 patients. Breast fibrosis was seen in 1 patient, tumor bed fibrosis in 3 patients, telangiectasia in 1 patient, and fat necrosis in 1 patient. Total 67 planes of implant analyzed as a comment on exit marks was missing in one patient. Dose at selected catheter was also the corresponding plane D_{max} . Spearman's co-efficient for correlation with quality of implant marks: dose at entry-exit: 0.214 ($p = 0.004$), distance from first/last dwell position: -0.027 ($p = 0.410$), distance from CTV: -0.165 ($p = 0.083$), distance from isodose: -0.081 ($p = 0.248$).

Conclusion: There is a statistically significant positive correlation between maximum dose received in a plane of implant and grade of marks. This study needs to be completed on a larger sample size, so that the dose constraints for entry-exit points can be determined.

[4]
Analysis of role of interstitial brachytherapy using template in locally advanced gynecological malignancies. A retrospective study from single institution

Swarna K. Chatharaju, Krishnam Raju Alluri, Tasneem Lilamwala

Department of Radiation Oncology, Basavatarakam Indo American Cancer Hospital and Research Institute, Hyderabad, India

Purpose: The aim of this retrospective study was to assess the treatment outcomes in patients with locally advanced gynecological malignancies treated with interstitial brachytherapy using Syed Neblett template to study local control, overall survival, and acute and late sequelae of the treatment.

Material and methods: 71 patients with histopathological confirmation of squamous cell carcinoma of cervix (56), vault (9), vagina (6) were treated by EBRT to the pelvis using 15 MV X-rays to a total dose of 5000 cGy, followed by interstitial brachytherapy using Syed Neblett applicator by transperineal approach between July 2010 to May 2016. Median age was 51 yrs. Only those patients who were unsuitable for intracavitary application or found to have probable improper dose distribution were treated by template. The dose delivered was 1500 to 2100 cGy treated in 3 fractions with a minimum gap of 6 hrs. between fractions on Varisource iX HDR.

Results: Among 71 patients, five patients were lost to follow-up and excluded from the study. The range of follow-up duration was 2 to 71 months. Median follow-up period was 20 months. Parameters studied were local control, acute and late sequelae, and distant metastasis. Local control was achieved in 54/66 (81.81%), local recurrence was seen in 12/66 (18.18%) patients. Out of 10 patients who developed distant metastasis, eight patients were locally controlled and two had local recurrence. Late sequelae, mainly vaginal stenosis was observed in 61/66 (92%). Local control was better with non-bulky tumors and in patients with good regression of the disease after EBRT.

Conclusion: Interstitial template brachytherapy using Syed Neblett applicator is a good alternative to deliver high dose radiation to patients with locally advanced gynecological malignancies, in whom it is unlikely to acquire a proper dose distribution with intracavitary radiation. Loco-regional control was significantly better than EBRT alone with acceptable complications.

[5] Dosimetric evaluation of image based brachytherapy using tandem-ovoid and tandem-ring applicators

Koti Krishna

Purpose: The aim of the study is to evaluate the differences in dosimetry between tandem-ovoid and tandem-ring gynecologic brachytherapy applicators in image based brachytherapy.

Material and methods: 100 CT datasets of cervical cancer patients (stage IB2-IIIb) receiving HDR application (50 tandem-ovoid and 50 tandem-ring) were studied. The external beam radiotherapy dose was 50 Gy. Brachytherapy was delivered using a CT-MRI compatible tandem-ovoid (50 patients) and a tandem-ring applicator (50 patients) to a dose of 8 Gy in 2 fractions. Bladder and rectum was contoured using Oncentra planning system. DVHs were calculated and D_{2cc} was recorded for bladder and rectum, and compared with the corresponding ICRU point doses. The point B dose, the treated volume, high dose volume, and the treatment time was recorded and compared for the two applicators.

Results: Table 1.

Conclusion: The results indicate that the OAR doses assessed by DVH criteria were higher than ICRU point doses for bladder with both tandem-ovoid and tandem-ring applicators, whereas DVH based dose was lower than ICRU dose for rectum. The point B dose, the treated volume, and high dose volume was found to be slightly higher with tandem-ovoid applicator. The mean D_{2cc} dose for bladder and rectum was lower with tandem-ring applicators. The clinical implication of the above dosimetric differences needs to be further evaluated.

Material and methods: Retrospective analysis of patients with oral tongue cancers who were treated with HDR interstitial brachytherapy using ^{192}Ir , between August 2010 and October 2015 were included in the study. Patients who have received brachytherapy as a salvage treatment for recurrences were excluded from the study. Endpoints were local control, disease-free survival (DFS), overall survival (OS), and late toxicity. Plastic tube technique was used as illustrated below.

Results: 14 patients treated at our institute were identified. Patient characteristics include: Male/Female = 9/5, median age 53.5 years, 71% grade II, median depth of invasion 8 mm, stage I and II - 10 patients, and stage IVA - 4 patients. In stage I and II, seven patients received brachytherapy after initial surgery: median dose 36 Gy/10 fractions, $\text{BED}_{10\text{Gy}}$ (range: 48-56), 2 patients after EBRT 50 Gy/25 fractions (dose 17.5 Gy/5 fractions, combined $\text{BED}_{10\text{Gy}}$ 84 Gy), and one patient received brachytherapy alone (45 Gy/9 fractions, $\text{BED}_{10\text{Gy}}$ 67.5 Gy). All stage IVA patients who declined surgery, received post-EBRT brachytherapy at 50.4 Gy/28 fractions (median dose 6 Gy/4 fractions, combined $\text{BED}_{10\text{Gy}}$ 82 Gy). Three of these stage IVA patients received neoadjuvant chemotherapy. Median follow-up period was 25.7 months (range:11.6-59.3) for stage I & II, and 25.5 months (range: 12-61.1) for stage IVA. Local control rates at 2 years were 90% for stage I & II, and 50% for stage IVA. Median DFS and OS were 20.7 and 25.7 months, respectively, for stage I and II, and 14.5 and 25.5 months, respectively, for stage IVA. Three patients who developed local recurrences were salvaged surgically, except one patient who declined surgery. One patient developed soft tissue necrosis and none developed osteoradionecrosis.

Conclusion: HDR interstitial brachytherapy provides good local control for early oral tongue cancers. In patients with locally advanced tongue cancers who decline surgery, brachytherapy can be considered as a treatment option in combination with external beam radiotherapy. However, due to paucity of data, a prospective multicenter trial with large number of patients is needed.

[6] Treatment outcomes of high dose rate interstitial brachytherapy in patients with squamous cell carcinoma of the oral tongue. A single institutional review

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Purpose: To evaluate the treatment outcomes of HDR interstitial brachytherapy in patients with squamous cell carcinoma of the oral tongue.

Table 1.

| Applicator | Mean D_{2cc} bladder (Gy) | Mean ICRU bladder (Gy) | Mean D_{2cc} rectum (Gy) | Mean ICRU rectum (Gy) | ICRU/ D_{2cc} ratio bladder | ICRU/ D_{2cc} ratio rectum |
|--------------|-----------------------------|------------------------|----------------------------|-----------------------|-------------------------------|------------------------------|
| Tandem-ring | 6.57 | 5.56 | 3.95 | 5 | 0.847 | 1.265 |
| Tandem-ovoid | 7.30 | 5.63 | 4.79 | 5.65 | 0.772 | 1.179 |

[7]
Dosimetric comparison of point based, manual forward, inverse planning simulation annealing (IPSA) and hybrid inverse planning and optimization (HIPO) – MR based intracavitary brachytherapy planning for cervical cancer

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Purpose: Newer axial imaging has facilitated from point based to widely practiced manual forward intra-cavitary brachytherapy (ICBT) planning in the management of cervical cancer. However, the manual forward planning is an operator dependent and time consuming. Magnetic resonance imaging (MRI) based ICBT have improved visualization and better delineation of the target volume and organs at risk (OAR). The availability of software optimizing tools such as inverse planning simulation annealing (IPSA) and hybrid inverse planning and optimization (HIPO) allows its utility with MRI volume based ICBT planning.

Aim: To compare dosimetrically various parameters of target volume and OAR in the MRI volume based ICBT planning of cervical cancer using dose volume histogram (DVH) for point based, manual forward, IPSA, and HIPO methods.

Material and methods: A prospective study of 15 consecutive patients treated with definitive radiochemotherapy for biopsy proven cervical cancer in May-June 2016 was conducted at Vydehi Institute of Medical Sciences, Bengaluru. All patients underwent external beam radiotherapy with dose of 45-50 Gy in conventional fractionation with concurrent weekly chemotherapy, followed by 3-4 fraction of MRI volume based ICBT for a total treatment duration of ≤ 8 weeks. GEC-ESTRO and ICRU-38 recommendations were used to define dosimetric parameters for MRI volume based and point based ICBT planning, respectively. The DVH of each patient was evaluated and compared for point based, manual forward, IPSA, and HIPO optimization for 1st fraction ICBT planning on MR images.

Results: The results of dosimetric parameters such as GTV D_{100} , GTV D_{98} , HRCTV D_{100} , HRCTV D_{98} , HRCTV D_{90} , HRCTV D_{50} , D_{2cc} , and $D_{0.1cc}$ for bladder, rectum, sigmoid, vagina, V_{150} , V_{200} , point A, point B, bladder point, rectal point, vaginal point, homogeneity index (HI), and conformity index (CI) will be presented in the conference.

[8]
Comparison of organ doses in supine versus lithotomy position during intracavitary brachytherapy in patients with cervix carcinoma

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Purpose: To compare the bladder, sigmoid colon, and rectum doses in supine versus lithotomy positions during intracavitary brachytherapy (ICBT) in cervix carcinoma patients.

Material and methods: 30 patients with FIGO stage IIB-IIIB received concurrent chemoradiation to 50 Gy/25 fractions/5 weeks with weekly cisplatin followed by 3 fractions of ICBT, 7 Gy each, 1 week apart. Following ICBT application, each patient underwent pelvic CT scan twice, first in supine and then in lithotomy position during first two applications, providing 60 data sets in each arm. Target – HRCTV and IRCTV and organs at risk (OAR) – bladder, rectum, sigmoid colon were contoured. Dose was prescribed to point A, and ICRU bladder and rectal reference points were identified. The DVH parameters for target (D_{90} , D_{100} , and V_{100} for HRCTV and IRCTV) and OAR (ICRU points for bladder and rectum, and $D_{0.1cc}$, D_{1cc} , D_{2cc} for bladder, rectum, and sigmoid colon) in both supine and lithotomy positions were evaluated.

Results: Median age was 52 years; 80% of patients had squamous cell carcinoma; 77% and 23% of patients were FIGO stage IIB and IIB, respectively; 73% had residual disease at the time of first ICBT. Mean dosimetric parameters for OAR in supine and lithotomy positions are shown in Table 1. HRCTV D_{90} was 9.96 Gy and 10.41 Gy in supine and lithotomy positions, respectively ($p > 0.05$). Patients felt more comfortable in supine position when compared to lithotomy position.

Conclusion: There were no statistical significant differences in target coverage and doses to OAR between supine and lithotomy position during ICBT in cervix carcinoma. Considering patient comfort, we recommend the standard supine position for treatment.

[9]
Perioperative HDR interstitial brachytherapy cannot replace brachytherapy in STS – a single institution study – South Indian data

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Purpose: In sync with the theme of IBS CON 2016 – BRACHYTHERAPY – AN IMMORTAL ART, we present this data from a single Indian institution, reconfirming the importance of perioperative brachytherapy in soft tissue sarcomas (STS) of the extremities and superficial trunk, and emphasizing the fact that treatment results are never the same without brachytherapy. This retrospective study from our institution aims to highlight the indispensable role of brachytherapy in achieving excellent local control rates and permitting function preservation of extremities.

Material and methods: From August 2007 to April 2015, thirty-one cases were retrieved and 20 cases were analyzed (14 primary and 6 recurrent). The follow-up period was between 13 and 93 months. The inclusion criteria for HDR and brachytherapy were as follows: 1. high grade tumor; 2. low grade tumor > 10 cm; 3. recurrent tumor; 4. positive/close margins. After reviewing either the pre-op biopsy report or frozen section reports and preoperative MRI of the site, catheters were placed equidistant to each other with 1-1.5 cm spacing with a margin of 1-2 cm from the tumor bed. Catheters were held by sutures to maintain the equidistance. On the 6th post-operative day, the patient underwent image guided (CT-based) planning, and 3-3.5 Gy/ fraction *6/7, twice daily were delivered. Three weeks later, the patient received EBRT (45-54 Gy). Median follow-up was 48 months.

Results: There were two cases of local failure within the radiation field and both patients expired due to distant metastasis. The local control rate was 90%. Among the late complications, 10% (2/20 patients) developed RTOG grade II restricted joint movements. One patient developed grade IV radiation dermatitis (non-healed ulcer till date). Fifty percentage of patients developed grade I myalgia, and 15% (3/20) had grade II myalgia (NCI-CT-CAE v4.0).

Conclusion: Immediate postoperative HDR brachytherapy with/without EBRT provides better local control rates than EBRT alone with acceptable complications.

[10]
High dose rate interstitial brachytherapy in vulvar cancer: single institutions 15-years of experience

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Purpose: To evaluate the role of HDR SBT approach in vulvar cancer and to report its clinical outcome data and toxicity results.

Material and methods: From January 2001 to January 2016, we performed a retrospective analysis of all case records of vulvar cancer patients treated with HDR-ISBT. Statistical analyses of overall survival (OS), disease-free survival (DFS) and local control (LC) rates were determined using Kaplan-Meier method.

Results: A total of 38 vulvar cancer patients with median age of 60 years had undergone ISBT. Among them, 29 patients were treated with definitive RT (6 with concurrent chemotherapy), 6 patients with adjuvant RT, and 3 patients for salvage RT. All of them received ¹⁹²Ir HDR ISBT with ($n = 29$) or without ($n = 9$) prior EBRT. Majority of implants were freehand plastic tube technique ($n = 23$) in single ($n = 5$) or multiple plane ($n = 18$); 13 patients had template based and two had a combination of freehand and template based volume implant. Patients who received BT as sole treatment received median EQD₂ of 38.4 Gy₁₀ and those patients who received ISBT as a boost received 23.3 Gy₁₀. At the end of 3 months of BT, 94.7% and 5.3% achieved complete response and partial response, respectively. Nine out of 36 patients with CR developed recurrent disease later: local in 4 (11.1%), regional in 3 (8.4%), and distant in 2 (5.5%) of cases. Of the 38 patients, 6 patients developed acute grade 3 skin reactions, and 7 patients had delayed complications. Median follow-up was 20 months. The 3-year actuarial OS, DFS, and LC rate was 64%, 64%, and 69%, respectively.

Conclusion: Improved local control with acceptable toxicity can be achieved with ISBT with or without EBRT. In this regard, HDR ISBT either as radical or as boost is an effective alternative option, and comparable clinical outcome with other treatment modality along with benefits of organ and function preservation.

C. Posters

[1]

Image based high dose rate interstitial brachytherapy in anal cancer – dosimetric and clinical outcome from a single institution

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Purpose: Definitive chemoradiotherapy is standard of care in management of anal carcinoma. Interstitial brachytherapy increases the dose to tumor volume and, at the same time, limits the volume of irradiated normal tissue, thereby decreasing long term side effects. Despite wide availability of HDR brachytherapy, there is limited data on brachytherapy for anal carcinoma. With an aim to assess the dosimetric and clinical outcome and long term side effects in patients of anal cancer treated with image based high dose rate interstitial brachytherapy following chemoradiation or as radical treatment.

Material and methods: Seven patients of anal canal cancer were treated from March 2010 to March 2016 and included in this analysis. Five patients were treated with external radiation therapy with or without chemotherapy followed by interstitial brachytherapy boost, and two patients were treated with radical interstitial brachytherapy. CT based planning was done after placement of needles using template (MUPIT). Target volume was contoured on CT scans and dosimetric parameters were evaluated after plan optimization. The patients were followed-up for local control and toxicity grading as per the RTOG scales. Local control, sphincter preservation rates, and disease free survival were evaluated.

Results: The mean clinical target volume was 25 ± 4 cm³, and D₉₀ and D₁₀₀ were calculated. The mean values of coverage index (CI), dose homogeneity index (DHI), overdose volume index (ODI), dose non-uniformity ratio (DNR), and conformal index (COIN) were 0.95, 0.58, 0.13, 0.40, and 0.57, respectively. The median follow-up, acute and late toxicities, local control, disease free survival, and rate of sphincter preservation were assessed.

Conclusion: The image based treatment planning provides better dose conformality with reduced toxicities and good sphincter preservation rates. The dose conformality can be assessed with volumetric quality indices and dose parameters.

[2]

A single institution study of external beam radiotherapy with or without intraluminal brachytherapy as a boost in the treatment of patients with esophageal cancer

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Purpose: This study reports the retrospective results of a single-institution experience with HDR intraluminal brachytherapy (HDR-ILRT) used as a boost in the treatment of esophageal cancer with external beam radiation therapy (EBRT) with or without chemotherapy.

Material and methods: Patients without evidence of metastatic disease were identified. Fifty-two untreated cases of squamous cell carcinoma arising from the middle or lower one-third of the esophagus, with no apparent extra-esophageal spread on a computed tomography (CT) scan and with a Karnofsky performance status of over 70 were chosen. Majority of them had been treated with EBRT to a dose of 50 Gy/25 fractions/5 weeks (30 Gy/15 fractions followed by 20 Gy/10 fractions to reduced volume on re-plan CT). They were further divided into two groups: those that received further boost with EBRT of about 10-20 Gy (group I) and those that received further boost with ILRT to a dose of 12 Gy in two sessions of 6 Gy each a week apart (group II). All patients were assessed symptomatically, endoscopically, and radiologically on follow-up.

Results: There was significant difference in relief of dysphagia, local control, disease free, and overall survival (better in the combined arm), although, the results were not always statistically significant. Incidence of strictures, other complications, and survival probabilities were also studied. Thus, EBRT and ILRT can give a better local response than EBRT alone for the same biological dose in the treatment of esophageal carcinoma.

Conclusion: HDR-ILRT is safe and beneficial for local control when added as boost in the radical treatment of patients with esophageal cancer.

[3] Customized brachytherapy for vaginal botryoid rhabdomyosarcoma in pediatric age groups

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Purpose: To report the technical aspects of customized high dose rate brachytherapy for recurrent vaginal rhabdomyosarcoma in pediatric age groups.

Material and methods: The pediatric patients are presented with a proliferative growth of the vaginal apex, which was reported as embryonal rhabdomyosarcoma (botryoid variant). In view of the large volume disease, a multidisciplinary approach of anterior chemotherapy followed by surgery was adopted. However, patients are recurred despite negative margin and was planned for re-excision, adjuvant radiotherapy, and further chemotherapy. The children were examined under anesthesia to determine anatomical dimensions of vagina. The vagina cylinder made with diameter of 1 cm and length of 5 cm. We created a wax cylinder to incorporate a single channel MR compatible tube. The root of the cylinder was expanded and customized to allow stability. Patients received an equivalent dose of 41.4 Gy (4 Gy, 7 fractions) by high dose rate brachytherapy (single fraction per day). The patients underwent a pre-plan prior to application. Taking into the consideration, the primary presentation of the disease, a treatment length of 4 cm was decided upon and 95% coverage was achieved with total rectal dose of 16 Gy and bladder dose of 15 Gy. The cumulative equivalent dose to the ovary was restricted to less than 4 Gy. The treatment was executed smoothly without any acute side effects or significant symptoms/side effects on follow-up.

Results: Pediatric vaginal rhabdomyosarcoma post-operative radiotherapy has been shown to improve local control and survival. Radiation to the pelvis in the pediatric age group for girls is associated with serious late effects like infertility, premature ovarian ablation, vaginal stenosis, and damage to reproductive structures that may result in miscarriages. Brachytherapy as a local modality can restrict some of these side effects. However, there is no standard applicator that can be applied for pediatric vagina of children in this age category. There is the need to create a customized applicator to suit the precise anatomy of the patient under consideration. At our Institute, we have successfully created a simple single channel MR compatible vaginal applicator and could successfully execute the desired treatment regimen.

Conclusion: A customized applicator provides the advantages of effective brachytherapy treatment that can restrict dose to normal tissues and is easily reproducible.

[4] Intraluminal brachytherapy for advanced cholangiocarcinomas: survival results

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Purpose: Cholangiocarcinoma is a dismal disease, presenting in advanced stage, which is not amenable for curative resection and not much has developed in this area. Liver transplantation has been proposed to be a curative treatment modality for locally advanced hilar tumors with no evidence of extrahepatic tumors. External radiotherapy can achieve satisfactory local tumor control but ILBT imposes a high radiation dose to the tumor volume, bypasses the radiosensitive structures, and therefore, spares the surrounding normal structures from radiation toxicity.

Objectives: To assess the survival outcomes in advanced, unresectable cholangiocarcinoma patients with intrabiliary intraluminal brachytherapy intervention.

Material and methods: A total of six unresectable cholangiocarcinoma males' patients in the age group of 38-80 years were studied. All patients had a percutaneous biliary drain inserted (PTBD) (9-12 French catheters) prior to ILBT. One patient received EBRT along with ILBT, the rest received only ILBT. The number of brachytherapy sessions ranged between 1 to 5. Treatment volume encompassed the stricture site with an additional margin proximally and distally. Treatment was delivered with a HDR ¹⁹²Ir afterloader.

Results: No serious toxicities were reported immediately after, or during the treatment. Overall survival was in the range of 6 to 16 months.

Conclusion: ILBT in cholangiocarcinomas is not very commonly practiced. It is worthwhile to reconsider its evaded potential on local tumor control and symptom free survival by proper randomized controlled trials.

[5] Interstitial brachytherapy for soft tissue sarcomas – treatment outcomes

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Purpose: Soft tissue tumors(STS) of extremities are rare tumors. Radiotherapy is an integral component in the treatment of soft tissue sarcomas; interstitial brachytherapy has added advantage in delivering boost or radical dose, sparing the critical organs.

Objectives: We examined the treatment outcomes of soft tissue sarcomas (STS) in patients who underwent surgery followed by interstitial brachytherapy with or without chemotherapy.

Material and methods: We studied interstitial brachytherapy (ISBT) of extremity sarcomas in 10 patients (8 lower extremity and 2 upper extremity) aged between 12-60 yrs., comprising of 7 males and 3 females. 80% of patients underwent per-op brachytherapy implant, remaining 20% underwent post-operative implant. Brachytherapy consisted of high dose rate, iridium-192 implant. 40% had combined EBRT and ISBT, ranging between 4 to 10 sessions of ISBT. Patients were followed-up for a period of 12 to 76 months.

Results: Complete local response was achieved in 80% of patients, one patient had partial response, one patient expired due to chemotherapy related neutropenic sepsis. Overall survival rate was 90%.

Conclusions: ISBT (interstitial brachytherapy) is a safe procedure producing excellent results in terms of local control. Reconstructed flaps were well taken.

[6] MRI based image-guided brachytherapy for cervical cancer in an Indian tertiary center – an institutional experience

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Purpose: Brachytherapy plays an essential role as a part of the cervical cancer management for its ability to deliver high dose to the tumor while reducing the dose to the surrounding critical organs. Over the last few years, the use of 3D image based brachytherapy has been revolutionized. In 2005, recommendations for 3D image based brachytherapy were developed by Groupe Europeen de Curietherapie of the European Society for Therapeutic Radiology and Oncology (GEC-ESTRO) has now become standard. Vienna group and EMBRACE study group have reported a promising clinical outcome of patients treated with MR image-guided adaptive brachytherapy with excellent local control rates. However, there is paucity of Indian data on MRI volume based brachytherapy in management of cervical cancer, thereof, the study was undertaken to know the utility of GEC-ESTRO recommendations in our settings. With an aim to assess the tumor response, local control and toxicities and/or depending on the response after radiochemotherapy treated with MR based brachytherapy in cervical cancer.

Material and methods: A study of 50 biopsy proven cervical cancer patients with stage IB2-IVA was recruited at Vydehi Hospital, Bangalore. All the patients have undergone EBRT to a dose of 45-50 Gy in conventional fractionation with concurrent weekly chemotherapy, followed by 3-5 fractions of brachytherapy with 5-7 Gy/fraction, and treatment duration \leq 8 weeks. A pre-EBRT MRI was taken, along with a CT simulation. On the first fraction of BT, a MRI scan was taken along with the BT applicator (MRI-BT) and on subsequent sittings; CT sim-

ulation was done, which was fused with MRI-BT. The GTV, HR-CTV and OAR were delineated and planned according to GEC-ESTRO recommendations. Patients were followed-up 6 weeks after completion of treatment, then every 3 month for assessment local control and toxicity.

Results and conclusions: Were discussed during the conference.

[7] Evaluation of acute toxicity in patients of carcinoma cervix treated by three different schedules of HDR intracavitary brachytherapy

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Purpose: To evaluate acute toxicity in patients of carcinoma cervix who were treated with three different schedules of HDR intracavitary brachytherapy.

Material and methods: Locally advanced and medically inoperable contraindicated early stage carcinoma cervix patients were treated with either neoadjuvant chemotherapy followed by radiotherapy or concurrent chemoradiotherapy, or only radiotherapy followed by any of the three schedules of intracavitary brachytherapy consisting of 7 Gy in 3 sessions, 4 Gy in 6 sessions, or 6 Gy in 3 sessions. Patients were evaluated for acute toxicity as per RTOG criteria.

Results: 130 histopathologically proven squamous cell carcinoma cervix patients were analyzed from 2008 to August 2014. Total number of patients in three various schedules of brachytherapy group (7 Gy x 3 sessions, 6 Gy x 3 sessions, 4 Gy x 6 sessions) were 43, 38, and 49, respectively. Acute toxicities such as diarrhea was 18.60%, 13.15%, and 22.45%, urinary tract toxicities were 13.95%, 13.15%, and 8.16%, nausea and vomiting were 23.25%, 23.68%, and 26.53% in three schedules of ICBT respectively. Grade I skin reactions were in the range of 65.1%, 76.31%, 67.35%, grade II were 27.90%, 15.79%, 24.49%, and grade III were 6.98%, 7.89%, 8.16% for three schedules of ICBT. Grade I mucosal reactions were in the range of 69.77%, 73.68%, 69.39%; grade II were 23.26%, 18.42%, 21.49%; grade III were 6.98%, 7.89% and 6.12%.

Conclusion: Our analyzed results of the study showed mixed results with diarrhea, nausea, and vomiting. Grade III skin reactions were seen in 4 Gy x 6 sessions group. Grade II skin reactions and grade II mucositis were more common in 7 Gy x 3 sessions group. Grade I and grade III skin reactions were more common. Further studies should be conducted with various schedules of brachytherapy to assess acute toxicities and optimal brachytherapy schedule.

[8] CT-based HDR interstitial brachytherapy in advanced cervical cancer – dosimetric evaluation and critical organ toxicity patterns

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Purpose: Investigated CT-scan based high dose rate interstitial brachytherapy (HDR-ISBT) planning for uterine cervical cancer based on GEC-ESTRO guidelines. The objective of the study was dosimetric evaluation, critical organ toxicity pattern, and local control.

Material and methods: 20 cervical cancer patients were enrolled. ISBT was performed using Syed Neblett template. Total treatment doses were 6 Gy in 3 fractions (brachytherapy) combined with external beam radiotherapy 45 Gy in 25 fractions, at 1.8 Gy per fraction. Treatment plans were created based on planning computed tomography. DVHs of the high-risk clinical target volume (HR CTV), intermediate-risk CTV (IR CTV), and the bladder and rectum were calculated. Indices were calculated on brachytherapy plans. Dose values were biologically normalized to equivalent doses in 2 Gy fractions (EQD₂).

Results: The median D₉₀ (HR CTV) and D₉₀ (IR CTV) per fraction were 6.09 Gy (range: 3.57-6.81), and 4.35 Gy (range: 1.92-5.29), respectively. The median V₁₀₀ (HR CTV) and V₁₀₀ (IR CTV) were 90.82% (range: 67-97), and 54% (range: 40-73.9), respectively. When the dose of EBRT was added, the median EQD₂ D₉₀ and D₁₀₀ of HR CTV were 66.65 Gy and 53.45 Gy. The D_{2cc} of the bladder was 66.5 Gy (range: 56.8-78.4) and of the rectum was 67.9 Gy (range: 61.7-73.9). The mean CI and HI were 0.728 and 3.18, respectively.

Conclusion: Our method of image-based ISBT using CT-scan was feasible. The CT-based BT tissue delineation seems adequate and appears to be valid for evaluation of OAR. At present, MRI remains the reference standard for contouring tumor volumes. 30% patients achieved complete response and are disease-free; 50% patients achieved partial response.

[9] Variation in applicator positions during interfraction high dose rate brachytherapy in cervix carcinoma and its implications

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Purpose: The optimal integration of intracavitary brachytherapy (ICBT) and external beam radiotherapy

is important in the treatment of cervix carcinoma. While high dose rate ICBT has become popular due to its logistical advantages over low dose rate ICBT, it necessitates dose fractionation to reduce normal tissue complications [1]. There are inadvertent changes in the position/geometry of the applicator and interfraction deformations in organs at risk (OAR) due to movement, shape changes, and variable filling of these hollow organs. This results in considerable variation of dose to surrounding normal tissues due to steep dose gradient in regions close to the brachytherapy source.

Material and methods: This study was designed to answer the following two specific questions. What was the magnitude of interfraction dose variation to OAR? And: Can re-planning with each fraction be avoided in a subset of patient population with minimal variation in applicator geometry? For this study, orthogonal films of 100 patients, treated from March 2014 to June 2016, were evaluated. Treatment planning and the dose distribution were evaluated using Nucletron Plato Treatment Planning System.

Results: The results will be presented at the conference.

[10] Dosimetric effect of bladder filling in CT based intracavitary brachytherapy planning of cervical cancer

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Purpose: Brachytherapy remains an integral part in the management of cervical cancer. During the process of brachytherapy, the volume of surrounding distensible structures such as urinary bladder, rectum, and bowel may have its impact on dosimetric coverage of target volume and exposure of high dose rate radiation to organs at risk (OAR). Various degrees of bladder distension can be used to alter the position of uterine cervix tumor target and shift OAR away to achieve better tumor control.

Objectives: To dosimetrically compare the effect of bladder filling on various parameters of tumor target and OAR in CT volume based ICBT planning for treatment of cervical cancer.

Material and methods: A prospective study of 10 consecutive patients treated with definitive radio-chemotherapy for biopsy proven cervical cancer from May to June 2016 was conducted at Vydehi Institute of Medical Sciences, Bengaluru. All the patients underwent external beam radiotherapy to a dose of 45-50 Gy in conventional fractionation with concurrent weekly chemotherapy, followed by 3-4 fraction of ICBT for a total treatment duration of ≤ 8 weeks. The bladder filling with 1 : 10 iohexol diluted normal saline was done with brachytherapy applicators before simulation and treatment. GEC-ESTRO

recommendations were used to define dosimetric parameters for CT volume based ICBT planning. The DVH of each patient was evaluated and compared for no filling, 50 ml, 100 ml, and 200 ml bladder filling for each fraction ICBT planning on CT images.

Results: The results of dosimetric parameter for no filling, 50 ml, 100 ml, and 200 ml bladder filling for ICBT planning for each patient such as GTV D_{100} , GTV D_{98} , HRCTV D_{100} , HRCTV D_{98} , HRCTV D_{90} , HRCTV D_{50} , D_{2cc} and $D_{0.1cc}$ of bladder, rectum, sigmoid, vagina, V_{150} , V_{200} point A, point B, homogeneity index (HI), and conformity index (CI) will be presented in the conference.

Conclusion: Will be presented in the conference.

[11]

Dosimetric evaluation of bladder and rectal radiation dose in cervix carcinoma patients using Cobalt-60 as source in HDR brachytherapy

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Purpose: Dosimetric evaluation of bladder and rectal radiation dose in cervix carcinoma patients using CT simulation and Cobalt-60 as source in HDR brachytherapy.

Material and methods: From January 2016 to June 2016, 30 eligible patients of age 30-60 years with squamous cell cervix carcinoma of all stages up to III B, completed EBRT and were scheduled for brachytherapy. All patients were treated with conventional EBRT 50 Gy in 2 Gy/fractions for 5 days a week/25 fractions, followed by 2 fractions ICA application consisted of placement of intra-uterine tandem 4 to 6 cm into uterine cavity after dilatation, and ovoids in vagina at the level of fornices. This was followed by gauze packing in anterior and posterior vaginal space to displace the bladder and the rectum away from and to fix the applicators in position.

Results: CT simulation of 2 mm thickness was obtained, 2 cm above the tandem superiorly and to the level of pubic symphysis inferiorly (from Barnard Institute of Radiology). Planning target volume, rectum, and bladder were contoured. Treatment planning were carried out using HDR plus treatment planning system based on ICRU 38 recommendations. Point A and point B, bladder and rectal doses were studied after the treatment was carried out using Cobalt-60 HDR remote after loading machine.

Conclusion: Out of the 30 patients, the average dose received by point A, point B, bladder, and rectal points were within tolerable limits, which is shown in the tabular column.

[12]

Can combined intracavitary-interstitial brachytherapy approach improves dose and volume parameters in locally advanced cervix carcinoma: a patient based dosimetric study

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Purpose: Conventional intracavitary brachytherapy would result in sub-optimal dose coverage in locally advanced cervix carcinoma, for which interstitial brachytherapy is the preferred option. Here, we investigate the feasibility of brachytherapy with combined intracavitary-interstitial (IC-IS) approach for patients with extensive parametrial involvement.

Material and methods: Two patients with cervix carcinoma FIGO stage IIIB with bilateral parametrial involvement up to lateral pelvic wall were treated with IC-IS applicator. Patient no 1 was treated with 3DCRT 45 Gy/25 fractions (treated elsewhere), and patient no 2 with IMRT 50 Gy in 25 fractions with concurrent cisplatin. After EBRT, the first patient had residual disease in the bilateral parametrium up to pelvic wall, cervix, and fornices. Patient no 2 had residual disease in the cervix and medial 2/3rd of right parametrium. Brachytherapy was performed under general anesthesia with IC-IS applicator, which consists of tandem, ovoids, and template for needles. After planning CT scan, HR CTV and organs at risk (OAR) were contoured according to American Brachytherapy Society guidelines. For the study purpose, three different plans were generated with different combinations of applicator and needles (i.e., conventional tandem and ovoids (ICBT), tandem and interstitial needles (ISBTWT), tandem-ovoids and interstitial needles (ISBTWTO)). Dose and volume parameters were evaluated and compared for both HR CTV and OAR.

Results: With ISBTWTO there was an average improvement of HR CTV D_{90} by 10% as compared with ISBTWT and 57% with ICBT. The average ratio of D_{90} HRCTV/ D_{2cc} bladder ((gain factor (GF)) were 0.95, 0.86, 0.68 in the ISBTWTO, ISBTWT, and ICBT, respectively, while GF for rectum were 1.2, 1.06, and 0.52, respectively, and 1.64, 1.63, and 0.63, respectively for sigmoid. ISBTWTO plan has better coverage (17.9% increase) at cost of increased V_{200} (10.5%) and V_{150} (14.9%) compared with ISBTWT plan.

Conclusion: ISBTWTO could be a comparable alternative to ISBTWT with improved coverage.

[13]
To evaluate late toxicity in cervix carcinoma patients treated with various schedules of HDR intracavitary brachytherapy

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Purpose: To evaluate the late toxicity in locally advanced and medically inoperable early cervix carcinoma patients treated with various schedules of EBRT, chemotherapy, and HDR-ICBT.

Material and methods: Between 2008 and 2014, 130 patients were treated in our Institute with either neo-adjuvant chemotherapy followed by radiotherapy or concurrent chemoradiotherapy, or only radiotherapy or concurrent chemoradiation therapy with platin analogs followed by any of the three schedules of intracavitary brachytherapy, consisting of 7 Gy in 3 sessions, 6 Gy in 3 sessions, or 4 Gy in 6 sessions. Cervix carcinoma patient with history of hysterectomy and carcinoma endometrium were excluded.

Results: Chronic toxicities such cystitis were 4.65%, 2.63%, and 8.16%; vaginal stenosis were seen in 13.95%, 7.89%, and 12.25%; proctitis were seen in 18.60%, 10.52%, and 16.33%, and dry vagina appeared in 11.63%, 15.79%, and 16.33% of patients in three schedules of HDR-ICBT of 7 Gy in 3 sessions, 6 Gy in 3 sessions and 4 Gy in 6 sessions, respectively.

Conclusion: Incidence of fibrosis, cystitis, and dry vagina are more common in receiving 4 Gy in 6 sessions of brachytherapy. Incidence of vaginal stenosis and proctitis were more common in case of 7 Gy in 3 sessions of brachytherapy schedules. This study emphasizes the importance of further randomized studies to assess late toxicities and optimal brachytherapy schedules.

[14]
Impact of different dose prescription schedules on biologic effective dose (BED) and 2 Gy equivalent dose in high dose rate intra cavitory brachytherapy for ca cervix

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Purpose: Brachytherapy is the most essential component of treatment of ca cervix patients. The era of LDR brachytherapy is fading and today, majority of the pa-

tients are treated by HDR brachytherapy. Though there was uniformity in dose prescription in LDR brachytherapy, there is a wide range of discrepancy in dose scheduling of HDR brachytherapy because of resources and logistic issues. Since the local control and toxicities depend on the total dose and dose per fraction, it is important to be aware of the biologic effective dose (BED) and 2 Gy equivalent dose (EQD₂) of different radiotherapy schedules.

Material and methods: It is a retrospective dosimetric study on 20 ca cervix patients post-external radiotherapy of 45 Gy in 25 fractions with weekly cisplatin who underwent intra cavitory brachytherapy (ICBT). CT scan simulation was done after insertion of ICBT applicators. Target and organ at risk were contoured according to GEC-ESTRO guidelines. Four different treatment plans were generated for each patient with dose prescriptions of 5.5 Gy x 4, 6.5 Gy x 4, 7.5 Gy x 3, and 9 Gy x 2 fractions to high risk CTV (HRCTV) by using HDR plus treatment planning system. D₉₀, V₁₅₀, V₂₀₀, BED, and EQD₂ for 2 cc bladder, 2 cc rectum, and point A were calculated. The results were analyzed by One Way ANNOVA test, using SPSS 15.0 statistical software.

Results: There was no significant difference in the values of D₉₀, V₁₅₀, V₂₀₀, BED, and EQD₂ for 2 cc of bladder and rectum ($p = 0.10$). BED and EQD₂ of point A were higher for prescription 6.5 Gy x 4 and 7.5 Gy x 3 fractions ($p = 0.0001$) (Figure 1).

Conclusion: Prescription of 6.5 Gy x 4 and 7.5 Gy x 3 fractions deliver higher BED and EQD₂ dose to point A compared to 5.5 Gy x 4, or 9 Gy x 2 fractions with acceptable doses to bladder and rectum in HDR intra cavitory brachytherapy for ca cervix patients.

[15]
Vaginal yolk sac tumor in a 2 year old child – treatment of recurrence with mould brachytherapy

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Purpose: Pediatric vaginal yolk sac tumor is an extremely rare clinical entity. Chemotherapy and surgery remains the mainstay of treatment, while radiotherapy has a definite role in select patients.

Material and methods: A one year and 3 months old girl was brought with a history of bleeding and spontaneous expulsion of a mass from vagina. Histopathological evaluation of the expelled mass revealed pure yolk sac tumor. Her AFP values were found to be elevated with normal BHCG. She received 5 cycles of JEB (bleomycin, etoposide, carboplatin) chemotherapy, followed by wide excision of residual with Martius labial fat pad graft.

Results: Her postoperative histopathology was reported as no evidence of malignant tumor. But after 2 months of follow-up, her AFP was found to be rising and vaginoscopy showed recurrence. She received next

line of chemotherapy with 6 cycles of VeIP (vinblastine, ifosfamide, cisplatin). The post-chemotherapy vaginoscopy revealed residual lesion. In view of the possibility of significant morbidity with repeat surgery and for organ preservation, brachytherapy was considered. She was treated with vaginal mould brachytherapy. Since the CTV included almost entire vagina, partial vaginal treatment was not considered. She received 3 Gy per fraction \times 14 fractions, 2 fractions per day. She is doing well with normal AFP levels and excision of probable residual on vaginoscopy being negative for malignancy at 3-month follow-up.

Conclusions: The obvious advantage of brachytherapy over external beam radiotherapy can be exploited in pediatric patients. The irradiated volume with brachytherapy can be kept significantly lower compared to EBRT. Thus, the late complications, which have a strong relation to a dose volume effect such as growth retardation, prevention of sterility, or chances of second primary tumors can be kept to a minimum with brachytherapy.

[16] Clinical outcomes and dosimetric optimization in CT based interstitial brachytherapy using MUPIT in gynecological malignancy

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Purpose: To evaluate the clinical outcomes and dose optimization using CT based planning in gynecological malignancy (cervical and endometrial cancer) undergoing interstitial (MUPIT) brachytherapy.

Material and methods: 30 patients with histologically diagnosed endometrial or cervical malignancy who underwent hysterectomy and received external beam radiation followed by HDR interstitial brachytherapy with MUPIT. The clinical target volume and organs at risk were delineated and optimization was done for optimum CTV coverage and sparing of organs at risk. The coverage index (CI), dose homogeneity index (DHI), overdose index (OI), dose non-uniformity ratio (DNR), external volume index (EI), conformity index (COIN), and dose volume parameters recommended by GEC-ESTRO were evaluated. The patients were followed-up and toxicities were graded as per RTOG scales, and local control rates and disease free survival were evaluated.

Results: The mean CTV volume, D_{90} , and D_{100} were calculated. The OAR, which included bladder and rectum were assessed for the volume along with D_{2cc} , D_{1cc} and $D_{0.1cc}$ were assessed for bladder and rectum/rectosigmoid. Mean CI, DHI, OI, DNR, EI, COIN were evaluated. The median follow-up was assessed and as per the

RTOG toxicity scale, it was used to evaluate the toxicities on follow-up for the patients. The local control rate and disease free survival were assessed at the same.

Conclusion: CT based planning using MUPIT for gynecological brachytherapy implants has good outcomes as assessed in our study. Plan evaluation and documentation using various indices and parameters recommended by GEC-ESTRO assist in objective evaluation and reproducibility, and correlate with clinical outcomes of the disease.

[17] Brachytherapy role in early endometrial cancer and quality of life assessment

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Purpose: To assess the role of brachytherapy in the form of central vaginal source (CVS) in early endometrial cancer and its relation with the functional quality of patients following treatment.

Material and methods: Between November 2015 and April 2016, 20 patients with early stage of endometrial cancer, treated in our department with external beam irradiation followed by brachytherapy (CVS) were included in this study. The patients were treated with 50 Gy in 25 fractions with external beam irradiation followed by brachytherapy with central vaginal source with varying diameter (2-3.5 cm) and applying 12-14 Gy in two fractions one week apart. The patient's quality of life was assessed, using European Organization for Research and Treatment of Cancer Quality of Life Questionnaire Core 30 (QLQ C30) and Endometrial Cancer Module QLQ EN24. The questionnaire was taken at starting of the treatment, before starting brachytherapy, and at the end of brachytherapy, and the results were analyzed using appropriate statistical tests.

Results: The patients showed better physical functioning after the use of brachytherapy as compared to that after external beam irradiation alone. The symptom score, lymphedema, pain, and diarrhea were also better after completion of brachytherapy. Among the sexually active patients, the sexual function was not worsened after brachytherapy. The functional scores were better in patients with normal body mass index as compared to those with obesity, especially lymphedema was affected in such cases.

Conclusion: The role of brachytherapy is an important part of treatment of early endometrial cancers and does not affect quality of life, especially the functional and sexual aspects as compared to outcomes after external beam irradiation. The BMI also affects the outcome in quality of life.

[18]
Evaluation of role of interstitial brachytherapy in soft tissue sarcoma: a single institute experience

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Purpose: Soft tissue sarcomas are rare group of solid tumors comprising of 1% of all solid tumors. The management of soft tissue sarcomas have evolved due to advancements in imaging, histopathology, cytogenetics, and the use of multimodality treatment. The treatment strategies emphasize on the control of disease locally, sparing of limb function, and improvement in the quality of life. High dose rate brachytherapy has formed a part of the management, and has the advantage of providing concentrated dose to tumors and sparing of surrounding normal tissues. In this study, we examined the clinical outcome of high dose brachytherapy for STS at our Hospital through retrospective analysis of the prospective database maintained.

Objectives: To review the clinical outcome and quality of life in patients with soft tissue sarcoma treated at our Center through high dose rate interstitial brachytherapy.

Material and methods: Eleven patients with different sites and grades of soft tissue sarcoma underwent surgery and intraoperative catheter implantations in a single plane in biopsy proven soft tissue sarcoma cases. Then, the patients underwent high dose rate brachytherapy with Iridium 192. The patients received an average dose of 3.5 Gy per fraction (two fractions per day, 6 hours apart) with total dose of 35 Gy/10 fractions/5 days, and after completion of treatment were followed-up at 1 month and later every 3 months for 2 years, followed by 6 months' interval.

Results: The patients were followed-up for range of 1-42 months (median: 12 months) and the overall control rate was 72.72%. The local recurrence was noted in only one patient (9.09%) and two patients developed distant metastases (18.18%).

Conclusion: The results in our study suggested the importance of HDR brachytherapy in management of soft tissue sarcoma. The local control rate was 72.72%. The dose of 35 Gy over 10 fractions in 5 days was found to be effective in local control and limb salvage in case of soft tissue sarcoma as practiced at our Centre.

[19]
Single institutional plan evaluation of interstitial HDR brachytherapy and 3D conformal radiation therapy in breast cancer after breast conserving surgery

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Purpose: Breast conserving surgery has formed a major treatment aspect in early breast cancer where the radiation therapy has formed an integral part in treatment of that disease. 3D-CRT is the technique of choice in the treatment and interstitial brachytherapy has been employed in select cases. We report a single-institutional dosimetric comparison of patients treated with two forms of accelerated partial breast irradiation: interstitial HDR brachytherapy and 3D conformal external beam quadrant irradiation (3D-CRT).

Material and methods: A retrospective dosimetric comparison of interstitial HDR brachytherapy and 3D-CRT was performed. Five patients were included for a dosimetric comparison of the dose received by the ipsilateral breast, PTV, heart, and ipsilateral lung. Interstitial patients were treated with 3.5 Gy in 10 fractions to 35 Gy. 3D-CRT patients were treated with 3.85 Gy in 10 fractions to 38.5 Gy using multiple iso-centric beams. The CT images from simulation or implant evaluation were transferred into our 3D treatment planning software. The lumpectomy cavities were outlined for every patient. The PTV was constructed as a uniform expansion of 1.5 cm for all interstitial HDR patients, and a 1.0 cm expansion in addition to the CTV expansion of 1.0 cm and 1.5 cm for the 3D-CRT patients. The CTV expansion for 3D-CRT and the PTV expansion for the brachytherapy patients were limited to the chest wall and skin. Normal structures including both ipsilateral lung and breast and heart for left-sided lesions were outlined. The lumpectomy cavity was subtracted from the PTV and normal breast tissue for evaluation. To evaluate dose to the ipsilateral breast and lung, PTV, and heart, a dose-volume histogram (DVH) analysis was performed. All histograms were normalized to the volume of the structure (i.e., expressed as percent volume).

Results: The average percentage of the breast receiving 100% and 50% of the prescribed dose (PD) was higher in the 3D-CRT group (24% and 48%, respectively) compared with interstitial patients (10% and 26%, respectively). Improved coverage of the PTV was noted in the 3D-CRT plans compared with interstitial HDR plans. With the interstitial HDR technique, 58% of the PTV received 100% of the PD compared with 100% with 3D-CRT techniques. The percentage of the PTV receiving 90% of the PD was 68% and 100% for the interstitial HDR and 3D-CRT patients, respectively. The ipsilateral lung V_{20} was slightly higher for 3D-CRT at 5% compared with 0%

for brachytherapy technique. The heart doses were found to be least with interstitial brachytherapy compared to 3D-CRT.

Conclusion: In those treated with 3D-CRT, the coverage of the PTV was better with 3D-CRT but varied with the definition used. The coverage at 90% of the PD, statistical difference was observed between 3D-CRT and interstitial brachytherapy (3D-CRT better than interstitial). 3D-CRT resulted in better coverage of the PTV compared with interstitial brachytherapy technique. Better PTV coverage with 3D-CRT came at the cost of a higher integral dose to the remaining normal breast. The lung dose, cardiac dose, and contralateral breast dose were minimal with interstitial brachytherapy compared to 3D-CRT. Dosimetrically, the best partial breast irradiation technique appears to depend on the clinical situation.

[20]

Weekly vs sequential high dose rate intra-cavitary brachytherapy for ca cervix

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Purpose: Radiotherapy (RT) for ca cervix patients is incomplete without brachytherapy. High dose rate (HDR) brachytherapy has shown an advantage over low dose rate (LDR) brachytherapy in terms of better nursing care and radiation safety. Unlike in LDR, various dose regimens are followed in HDR brachytherapy. Some institutes follow brachytherapy sequentially after external RT and some along with external RT during weekends. There are no comparative studies on sequential and weekend brachytherapy and hence in our study, we have focused on the radio biology of these two regimens.

Material and methods: We have conducted a dosimetric comparative study on 40 plans of 20 ca cervix patients post external RT of 45 Gy in 25 fractions with weekly cisplatin who underwent intra-cavitary brachytherapy (ICBT). CT scan simulation was done after insertion of ICBT applicators. Target and organs at risk were contoured according to GEC-ESTRO guidelines. Two different treatment plans were generated for each patient with dose prescriptions to high risk CTV (HRCTV) by using HDR plus treatment planning system. Plan A: 5.5 Gy once a week x 5 fractions, and Plan B: 5.5 Gy once every 6 hours x 5 fractions. Biologic effective dose (BED) and 2 Gy equivalent dose (EQD₂) for 2 cc bladder, 2 cc rectum, and HRCTV were calculated for both plans and compared by using Student *t*-test.

Results: Plan B showed higher BED and EQD₂ for HRCTV, 2 cc of bladder and rectum ($p = 0.0001$).

Conclusion: Sequential HDR ICBT for ca cervix patients of 5.5 Gy x 5 fractions with 6 hours interval between the fractions given after completion of external RT, deliv-

ers higher BED and EQD₂ to HRCTV compared to 5.5 Gy once a week for 5 weeks during external beam RT with acceptable doses to bladder and rectum.

[21]

Clinical outcomes of accelerated partial breast irradiation (APBI) using multi-catheter interstitial brachytherapy (MIB) grouped as per GEC-ESTRO consensus: single institution 2-year follow-up data

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Purpose: In patients with early breast cancer, an adjuvant radiotherapy is part of a standard of care for BCT. APBI is a hypofractionation irradiation approach that treats only the lumpectomy bed plus a 1-2 cm margin, rather than conventional whole breast irradiation (WBI). Despite the lack of level I evidence, preliminary results from several large national trials suggest that APBI is safe and effective option. Thus, several consensus groups including GEC-ESTRO, ASTRO, and ABS endorse the use of guidelines in selecting patients for APBI. The purpose of this study is to analysis clinical outcomes of patients treated in our Institution with MIB-APBI regimen in comparison to GEC-ESTRO consensus for patient selection.

Material and methods: Between 2012 and 2014, patients who underwent MIB-APBI with a minimum of 24 months of follow-up were retrospectively analyzed. Statistical analyses of overall survival (OS) and local control (LC) rates were determined.

Results: A total of 37 patients had undergone MIB-APBI with median age of 57 years. Freehand multiplanar intra-op implant was done in 20 patients, and post-op implant in 17 patients with median 20 catheters. As per analyses with GEC ESTRO consensus for patients' selection, our cohort consisted 10 (27%), 25 (67.6%), and 2 (5.4%) patients belonging to low, intermediate, and high risk group, respectively. With median follow-up of 36 months, 33 of 37 patients were alive, out of which two are alive with metastatic disease. Remaining 4 had died (2 had died of metastatic disease). None of the patients had a local or regional recurrence. Good to excellent cosmesis was achieved in 86% of entire cohort. 2 yr. OS and LC is 89.2% and 97.3%, respectively.

Conclusions: APBI brachytherapy needs to be customized individually and based on tumor-specific characteristics; it can be considered even in intermediate and highly selected cases of high risk group of GEC ESTRO consensus with enough risk for local failure.