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ORAL PRESENTATIONS

Basic Science and Translational Research

Cervical cancer screening: Role of serotyping of HPV as bridge of cytopathology and molecular typing?

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Aims: The aims of this study are to determine the prevalence of HPV infection and distribution of HPV genotypes in cervical cancer patients and also in women of age group 18-60 years and thereby estimate their role in cervical cancer screening and vaccination programs. The aim is also to have some insights in understanding the role of HPV serotyping, if any, in cervical cancer screening program. **Materials and Methods:** We analyzed 91 tissues from histological proven cervical cancer cases from Apollo Health City Cancer Hospital to evaluate the prevalence of HPV using GP5+/GP6+primers. All the samples which were positive for HPV were typed, using type specific primers HPV 16 and 18. The cervical scraps from about 500 women with age group 18- 60 were also processed to estimate HPV prevalence and type distribution. Serology of HPV was done as preliminary study, using GST capture ELISA at Indian Immunological Limited, from 21 samples of normal women and same number from cervical cancer patients. **Results:** Our results revealed that all the samples analyzed from cancer population except one, and 19% of normal women, is found to have HPV infection. About 80% of cancer patients were positive for HPV 16 and 2% are positive for HPV 18 and almost similar results were observed in normal population. As far as serology results are concerned, the serum antibody titer of HPV 18 was higher than HPV16 among cancer patients. The serum antibody titers were found to be significantly higher (2-3 log folds higher) from the cancer patients than normal women population. **Conclusions:** Our results confirm that HPV 16 is the most common type followed by HPV18 in cervical cancer and also in general population as found in other studies in India. As far as HPV serology results are concerned, it may have role as predictor for infection status, provided the serological assays are rigorously validated.

Genotype and phenotype correlation analysis in retinoblastoma

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Aim: Retinoblastoma (Rb), the most common intraocular malignant tumor in children has unraveled many of the mysteries of tumor biology, but still leaves us with few unanswered questions. In this study we have attempted a genotype-phenotype correlation in patients seen at a tertiary eye care centre in Southern India. **Materials and Methods:** Genomic DNA from blood samples of 70 Rb patients was evaluated for mutations using a comprehensive approach using PCR-RFLP, UPQFM-PCR (universal primer quantitative fluorescent multiplex PCR) and sequencing. Mutations were classified as large deletions or duplications; small deletions and insertions; and point mutations. Medical records of these patients were reviewed specifically for clinical grouping (International Classification of Intraocular Rb), treatment modalities, and the clinical outcome. **Results:** Of 53 bilateral Rb patients evaluated, mutations were detected in 41 (77%) patients. In the group of 20 patients with deletions (large deletions in 8; small deletions in 12), 13 had Group E Rb (33%). Histopathological risk factors (HRF) were seen in 5 of the 12 eyes that were enucleated. All the patients in this group were alive and well during the study period. In the group of 10 patients with nonsense mutations, Group E Rb was noted in 25% (5 of 20 eyes) and HRF in 2 of 7 enucleated eyes. All the patients in this group were alive and well during the study period. In 6 patients with splice site mutations, Group B and Group D Rb were noted in 8 eyes and enucleation performed in one. In this group, 5 of 6 patients on follow-up were disease free. Four patients with missense mutations had Group B Rb in 3 eyes; enucleation was performed in 4, of which 1 had HRF. All the patients in this group were alive and well during the study period. In 12 patients with no mutation, 13 (54%) eyes had Group D tumor and 9 (38%) eyes were enucleated. All the patients in this group were alive and well during the study period. In 17 patients with unilateral Rb, germline mutation was identified in 6 (35%) patients. The mutations included large deletions in 3; nonsense mutation in 1; splice site mutation in 1; and missense mutation in 1. Group E Rb was seen in 5 eyes (83%) and 4 eyes were enucleated (67%). Of the 11 patients with unilateral Rb where no mutation was identified, 8 (73%) eyes had Group E Rb and 9 eyes were enucleated (82%). Survival analysis of 13 patients available for follow-up showed 11 alive and well, 1 alive with metastasis and 1 died of metastasis. **Conclusion:** The present study indicates that genetic mutations involving deletions (large and small) are associated with relatively advanced disease at presentation (Group E), and higher rate of enucleation, both in bilateral and unilateral patients. Unilateral Rb interestingly showed mutations in 35% of patients. Long-term survival studies are required to evaluate the specific prognostic utility.

Breast Cancer

Comparison of early quality of life in patients treated with radiotherapy following mastectomy or breast conservation therapy: A prospective study

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Introduction: To compare quality of life (QOL) in breast cancer patients from a developing country after breast conservation surgery (BCS) or mastectomy and adjuvant radiotherapy (RT). **Materials and Methods:** In a six month period, all consecutive early and locally advanced breast cancer patients treated with either BCS or mastectomy and treated with RT were accrued. All patients who underwent mastectomy were treated with 45 Gray/20#/4 weeks. Patients with BCS were treated with a dose of 45 to 50 Gray/25#/5 weeks to whole breast followed by tumour bed boost (15Gray/6 #/6 days with suitable energy electrons). Prospective evaluation of QOL using EORTC QLQ C30 and breast cancer specific QLQ BR23 was done before starting RT, at mid-RT and at RT conclusion. **Results:** Among 225 patients filled QOL questionnaires 113 patients had mastectomy and 142 patients underwent BCS. Reliability test (Cronbach alpha) for questionnaire filling was 0.669 to 0.886. At pre-RT assessment, global QOL scores in mastectomy and BCS groups were 71.1 and 71.3 respectively. There was no significant difference in pre-RT EORTC QLQ C30 functional and symptom domains between mastectomy and BCS patients. However, social function domain score was higher in patients underwent mastectomy (83 versus 73.9; P = 0.018). In QLQ BR23 domains, body image and sexual functioning domains were similar between the two groups. However, sexual enjoyment (10.9 versus 47.6; P = 0.006) and future perspective (7.4 versus 37.1; P = 0.036) domain were significantly better in BCS arm. There was no difference between

systemic side effect, breast symptom and arm symptom domain scores between the groups. There was no significant difference in change of QOL scores between mastectomy and BCS patients at RT completion. **Conclusions:** Patients underwent mastectomy had poorer sexual function, sexual enjoyment and body image scores compared with BCS. Literacy, economic status and menopausal status did not influence QOL scores. There was no difference in change of QOL domain scores after RT in mastectomy and BCS patients.

Diagnostic accuracy of ultrasound guided mammotome vacuum biopsy in palpable breast lesion

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Objective: To assess the diagnostic accuracy (histological) of ultrasound guided mammotome vacuum biopsy in palpable breast lesions. **Introduction:** The mammotome breast biopsy system is minimally invasive, image guided procedure (stereo-tactic or ultrasound) that helps physicians locate breast abnormalities and obtain tissue samples for diagnosis. Ultrasound provides real-time images of the breast interior and the mammotomy procedure so that the physician can continuously visualize the progress of the biopsy. The advantage to using the mammotome is that it requires only a single insertion with minimal invasion and eliminates the drawback of multiple insertions. Mammotome technology also gives the pathologist a better opportunity to definitively diagnose not just the cancer, but its type and grade. **Materials and Methods:** We have performed mammotome breast biopsies in 50 patients requiring histological diagnosis from 17 May 2008 to 30 June 2009. The target lesion is identify through ultrasound then infiltrate local anesthesia at the site of mammotome procedure. After that mammotome probe insert through a tiny incision in the patient breast under guidance of ultrasound. Once the probe is positioned into target lesion, multiple contiguous tissue specimens obtain through mammotome probe without having to be repeatedly removed and inserted. **Results:** To achieve histological breast diagnosis, 50 ultrasound guided mammotome biopsies were performed. Definitive histological diagnosis of breast lesion was achieved in 47 patients and 3 patients need repeat biopsy. Diagnostic accuracy of histological sampling by ultrasound guided mammotome vacuum biopsy was 94% (47/50). The 6% (3/50) failure rate of mammotome vacuum biopsy was likely to be due to an error in the positioning of the probe. The most common complication during the procedure is bleeding which can be managed by compression and local haemostatic application. Other complication is pain at the biopsy site that is managed in simple medication. **Conclusions:** This study data suggest that ultrasound guided mammotome biopsy is both effective and safe for histological sampling of breast lesions. Further studies with larger number of patients are essential before definite conclusions can be drawn.

Central Nervous System

Stereotactic radiosurgery-our experience with 3D line

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Aim: To analyze the patterns of care and outcome with Stereotactic Radiosurgery using 3D Line at Amrita Institute of Medical Sciences, Kochi. **Materials and Methods:** Stereotactic Radiosurgery was started at our institute in January 2007. To date, we have treated 38 patients. We have ERGO^{++} planning system of 3D line & Elekta Precise Linear Accelerater with Dynamic MLC attachment of 3D line. The Leksell Coordinate frame with 'N' Frame is used. After the frame fixation, depth measurements were taken using earplug and depth helmet and recorded. MDCT was then taken with angiogram or MRI as required for target delineation. The patient, organs at risk and target were contoured. Where needed, MRI fusion was done at the Focal Workstation for delineating the target. The images were then transferred to the ERGO^{++} planning system. If MRI was not needed, the contouring was done using ERGO^{++} itself. The planning was done with appropriate arcs, with or without intensity modulation. Once the plan was satisfactory, the gantry collision with couch was checked for different arcs at the treatment machine. Laser alignment, isocentre with couch & gantry rotation were checked. The frame depth measurements were repeated before treatment to ensure stability of frame position. After fixing the frame to the couch and setting at the isocentre, orthogonal ports were taken before treatment execution. **Results:** Of the 38 patients, there were 14 cases of arteriovenous malformations, 10 acoustic neuromas, 7 meningiomas, 3 metastatic tumours, 2 pituitary adenomas and 2 glomus jugulares. The mean age was 40 years. There were 20 males and 18 females. Only 2 patients were treated with cones-the rest with Dynamic mini muti leaf collimators. The intensity modulation algorithm was used in 22 cases. The median number of arcs used was 5. The median dose was 12.5 Gy, prescribed to a median isodose line of 80%. The mean dose to the brainstem was 133cGy and to the chiasm 76.4cGy. At a median follow up of 24 months, 50% of acoustic neuromas showed some regression, 75% of meningiomas and AVMs were smaller one AVM had disappeared at 12 months post treatment. **Conclusion:** Use of 3D Line makes delivery of stereotactic radiosurgery easier, although there is a learning curve involved. AVMs seem to respond more than the other tumor types, probably because of their smaller size. However, longer follow up is required to comment on this.

The results of radiation therapy in craniopharyngioma: AIIMS experience

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Introduction: Craniopharyngiomas remains a challenging disease to treat because of proximity to critical organ and young age at presentation. We retrospectively analysed the records of all patients with craniopharyngioma treated in department of radiotherapy at our institute from 2004 to 2006. **Results:** Fifty five patients were treated during this period. 75% were male and 25% were female. The mean age of patients is 20 years (range 5-67 years; median 16 years). Visual impairment was the most common symptom (85%) followed by headache (63%) and vomiting (23%). The mean duration of symptoms was 14.6 months. Majority of the patients (75%) underwent subtotal excision while 25% of patients underwent total resection. Repeat surgery was done in 4 of them. All patients received post operative radiotherapy. 42% of patients received radiation by 2 field technique on telecobalt and 48% received radiation by 3DCRT on linear accelerator. Only 10% patients received stereotactic radiotherapy. Median follow up was 11.6 months (range 1-148 months). Only thirty-four patients were on follow-up. Sixteen patients developed late toxicity which includes diabetes insipidus, growth failure and blindness. Eleven patients had persistent radiological evidence of residual disease. **Conclusion:** The mean age and symptom complex in our patients was comparable with reports from other case series. Majority of our patients underwent 3D conformal radiotherapy following surgery. SRS/SRT is being underutilised in this tumor. Poor follow-up remains a concern.

Evaluation of outcome and prognostic factors in glioblastoma multiforme: A single institution experience

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Aim: To evaluate the survival of patients with Glioblastoma Multiforme (GBM) and analyse the prognostic factors influencing survival. **Materials and Methods:** This is a retrospective analysis of 306 patients of GBM registered in the Department of Radiotherapy from January 2004 to December 2008. Two-hundred and five patients (67%) were males and 101 (33%) were females. The mean age of patients

was 48.42 years (Range: 6-75 years; 135 patients were ≤ 50 years, 115 patients were >50 years). Thirty-four patients (11.1%) underwent complete excision, 202 (66%) near total excision, 38 (12.4%) subtotal excision, 27 (8.8%) decompression and 5 patients (1.6%) biopsy only. One hundred and ninety-nine patients (70.6%) had Karnofsky performance score (KPS) ≥ 70. We evaluated only those 250 pts who received Radiotherapy. One hundred and eighty-eight patients received Radiotherapy dose of ≥50 Gy @ 2 Gy per fraction. Rest of the patients received RT dose of less than 50 Gy (Range: 20 Gy-46 Gy). Sixty-six patients received some form of chemotherapy (Concurrent or Adjuvant) with CCNU (Lomustine) or Temozolomide. Steroids were used in 145 patients (58%) during RT. The overall survival was calculated using the Kaplan-Meier method and prognostic factors were determined by log rank test. **Results:** The median follow up was 8.14 months (Range 1.4 to 39.5 months). At the time of analysis, 26 patients were coming for follow-up, 16 patients without symptoms and 23 patients with symptoms were lost to follow up. The median survival was 8.37 months. The overall survival at 1-year, 1.5-year and 2-year was 29.67%, 15.86% and 9.69% respectively. All the patients were analyzed for various prognostic factors such as Age (≤ 50 vs >50 years), Gender (Male vs Female), extent of Surgery, KPS before starting RT (< 70 vs ≥ 70), RT dose (<50 Gy vs ≥ 50 Gy), use of Chemotherapy (Concurrent and/or Adjuvant), use of Steroids during RT and Field size (£ 100 cm^2 vs >100 cm^2). In univariate analysis, Age >50 years (P = 0.01), KPS < 70 (P = 0.014), RT dose < 50 Gy (P = 0.00), use of Steroids during RT (P = 0.006) and administration of RT alone (without use of chemotherapy; P = 0.002) were statistically significant prognostic factors. **Conclusions:** In patients with GBM; age at presentation, KPS before starting RT, dose of RT, requirement of steroids during RT and administration of chemotherapy (Concurrent and/or Adjuvant) are important prognostic factors determining survival. However, inspite of using multimodality treatment, the overall survival and prognosis in GBM patients remain dismal and majority of the patients die within first two years of diagnosis.

Intensity modulated radiotherapy in high grade gliomas: Pros and cons

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Aims: Three dimensional conformal radiotherapy (3D CRT) is standard practice in high grade gliomas, given the high dose and generous margins required. The potential of IMRT to spare normal tissues such as the brain stem and the optic apparatus makes it an attractive tool to potentially improve post-radiotherapy quality of life. The present study has been an effort to analyse the potential dosimetric benefits of IMRT. **Materials and Methods:** Twenty five patients of high grade glioma in a variety of locations underwent contrast CT scan. The clinical target volume (CTV) was contoured as the contrast enhancing area as seen on pre-operative T1-weighted MRI with a 2cm margin, while the planning target volume (PTV) included the CTV with a 0.5 cm isotropic margin. For each patient, the best achievable 3DCRT & IMRT plans were generated, keeping in mind both the target coverage and normal tissue tolerance to deliver 59.4-60 Gy at 1.8-2 Gy/# to the PTV. The two sets of plans were compared to evaluate differences in both target coverage and normal tissue sparing using the Wilcoxon matched pairs signed rank test. **Results:** PTV coverage was not significantly improved by IMRT (P = NS for PTV 95% although P < 0.001 for PTV average) and dose homogeneity within the PTV was significantly worse (P < 0.001 for PTV 5%, P < 0.001 for PTV 20%). On the other hand, IMRT significantly improved the conformality of the prescribed dose (P < 0.001 for conformity index). The doses to the critical structures were not significantly different across all sites in the brain, except for a significant reduction of the optic chiasm dose (P = 0.02) with IMRT. Importantly, dose to the whole brain was significantly reduced with IMRT (P < 0.001 for dose to 33% of the whole brain and P = 0.001 for average whole brain dose). **Conclusion:** IMRT helps to improve conformality without having an impact on tumor coverage and also at the expense of more dose inhomogeneity within the PTV. Dose to the uninvolved brain is significantly less in case of IMRT which might have a significant impact on global neurocognitive status and improve post-radiotherapy quality of life. Overall, IMRT does not impart a significant advantage in terms of OAR sparing.

Management of brain secondaries by concurrent chemoradiotherapy versus radiotherapy: A comparative study

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Aims: In our department we intended to study the effectiveness of oral chemotherapeutic agent temozolomide along with whole brain radiation therapy in managing brain secondaries. **Materials and Methods:** We performed a prospective study in the Department of Radiotherapy, I.P.G.M.E&R and SSKM Hospital from May 2008 to May 2009. Total 32 patients were selected and they were divided into 2 broad groups. Among those 2 groups patients were again allocated as per treatment received. One group of patients received only whole brain radiation therapy and the second group had whole brain radiation therapy along with oral chemotherapy Temozolomide. All these patients were followed up by both clinical and radiological investigations primarily for assessing quality of life. The follow up period was 6 months. The quality of life was assessed by FACT-Br criteria. **Results:** The primary objective being quality of life, it has been found in our study that the group receiving whole brain radiation therapy along with oral chemotherapy tablet Temozolomide fared well than the control arm though it was not statistically significant. It was noticed that toxicities in arm A was statistically significant (P value < 0.001). The radiological improvement was also noted (P value 0.046) over a period of time quality of life also improved in arm A (P value 0.0014). **Conclusion:** Although the median survival was around 3-4 months in most of the cases of brain secondaries, the investigational arm showed that number of patients had good quality of life and radiological stable or partially regressed disease at least in first 2 months in comparison to standard arm. So tablet Temozolomide in conjunction with whole brain radiation therapy has definite role in management of brain secondaries.

Gastrointestinal Cancers

External beam radiation in the management of anal cancer

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Background: Anal canal cancer has an excellent prognosis. The cure rate is high and the probability of loss of the anal sphincter function is minimal. Most therapeutic regimens currently in use for sphincter preservation in anal canal utilize combined radiation therapy and chemotherapy. To provide a basis for comparison of the various treatment modalities in anal carcinoma namely EBRT, interstitial implant, systemic chemotherapy alone or in combination, a retrospective audit was conducted. **Materials and Methods:** Thirty five patients with a histological diagnosis of anal canal treated with EBRT in the Department of Radiotherapy Christian medical College and Hospital Ludhiana between January 1, 1991 to 31 December 2006 with the goal of sphincter preservation and cure. All patients had histopathological confirmation of the disease by biopsy, 5 patients underwent abdominopelvic resection and 3 had defunctioning colostomy before initiation of EBRT. All patients were planned for radical EBRT with a curative intent and 29 out of 35 patients completed the planned course of radiation therapy. Twenty six out of the 29 patients received a total radiation of 50 Gy or more in the form of boost. **Results:** With the follow- up of 1.5 to 82 months in surviving patients, freedom from local recurrence was 89.4% in patients who received a

total dose in the range of 60- 70 Gy and 75% in the dose of 50 Gy. No patients required a permanent colostomy or had permanent loss of anal sphincter function as a result of local recurrence or complications due to radiation. **Conclusion:** These results combined with others, suggest that in patients who are not candidates for chemo radiation in view of co morbidities and poor general condition, EBRT alone without chemotherapy is an acceptable alternative in the management of anal carcinoma when the total dose is escalated to 65-70 Gy.

Role of neoadjuvant chemoradiation in carcinoma rectum

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Aims: To evaluate the rate of sphincter preservation, tumor downstaging, local control and acute toxicities of Neoadjuvant chemoradiation for locally advanced distal rectal carcinoma. **Materials and Methods:** Patients with clinical T3/T4 and N1/N2 cancer of distal rectum were taken into the study to receive Combined Neoadjuvant chemoradiation followed by surgical resection. All the patients were given inj. Leucovorin (30 mg/m^2) and inj. 5-FU (325 mg/m^2) D1 concurrently with radiation of 45 Gy/25# @ 1.8 Gy for 5 weeks. Surgery was performed 4-6 weeks after completion of chemoradiation. The primary end points of this study are tumor regression and sphincter preservation and acute normal tissue toxicities were taken into account as secondary point. **Results:** A total of 38 patients have been evaluated from July 2007 to July 2009. The study shows a complete pathological response rate of 37%, overall resectability rate of 80% and a sphincter preservation rate of 55% (LAR). Only 20% patients were declared inoperable in whom palliative colostomy were done. Non hematological toxicities (diarrhoea of grade III-21% and skin reaction of grade II- 16% and grade III-5%) were main complication observed during neoadjuvant chemoradiation. Grade II neutropenia- 5% and grade I thrombocytopenia-5% were seen. With a median follow up period of 6 months no loco regional failure has been seen. One patient has failed distantly presenting with lung metastasis without any local failure. **Conclusion:** Concurrent preoperative chemoradiation for locally advanced carcinoma rectum is associated with improved tumor resectability which results in improved sphincter preservation, local control and is relatively safe, effective and well tolerated.

Genitourinary and Gynaecological Cancers

Concurrent chemoradiation for organ preservation in carcinoma of urinary bladder: PGIMER experience

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Introduction: Gold standard for treatment of muscle invasive carcinoma of urinary bladder is radical cystectomy. Radical cystectomy results in compromised quality of life. Even after radical cystectomy, 40-50% of patients will succumb to distant metastases within 5 years. Concurrent Chemo Radiation increase Radio sensitivity, improves local control. Optimal chemotherapy regimen and sequencing of radiation to maximize bladder preservation rate are not yet defined. **Aims and Objectives:** To see Loco regional control using concurrent Chemo Radiation in muscle invasive bladder carcinoma. **Materials and Methods:** Thirty two patients fulfilling the prefixed selection criteria received external beam Radiotherapy 60 Gy/30#/6 wks along with cisplatin 20 mg/m^2 D1-5 in 1st an 5th wk of radiation. First 40 Gy/20#/4 wks given to whole pelvis and rest 20 Gy/10#/2 wks given to bladder as boost. All patients were treated in Co 60 or 6 MV Linac. Check cystoscopy and CT scan were done after 3 months of completion of radiation. Acute treatment related toxicity noted every weekly and graded by using Common Terminology Criteria for Adverse Events v3.0 (CTCAE). Survival analysis done by Kaplan-Meier test. **Results:** Total 32 patients were treated from 2003 to June 2oo8. Median follow up period was 36 months. Median age was 64 yrs with ranging from 34 to 85 yrs. Local disease control seen in 80%. Five yrs disease free survival (DFS) is 58%. Five Yrs overall survival (OS) is 64%. Acute toxicity noted were vomiting (Gr-II) in 10 patients, diarrhea in 25 patients (Gr.I-12, Gr.II-13). Hematological toxicity seen in 4 patients. All patients treated conservatively. **Conclusion:** Chemoradiation is effective, feasible and without any increase in acute morbidities.

Year survival study of cancer esophagus treated by neoadjuvent chemotherapy followed by radiotherapy

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Aim: Where oncosurgery & imaging facility is not available/affordable & those who don't prefer surgery for Cancer Esophagus are treated by Neodjurent chemotherapy followed by radiotherapy. This study is to see the outcome of this treatment protocol. **Materials and Methods:** 991 Patients agreed for this protocol. Cisplatin - 80 mg/m^2 (divided in D_1 & D_2), 5-FU-700 mg/m^2 (D_1, D_2) treated on D_1, D_{21}, D_{42}. After 2 weeks of last chemotherapy, 44 Gy EBRT (conventional) then HDR (7.5 Gy EOD X 3f) or oblique field EBRT to total dose of 66 Gy. Clinical response (subjective & objective) were observed at the end of chemotherapy, and 1st month after RT, then at 3rd, 6th & 12th month & every year till 5th year. **Results:** 215 patients of upper third, 547 of middle third & 229 of lower third esophagus (Total = 991) agreed for this protocol (Age 39-70 years, ECOG performance status O, 1, 2). At end of chemotherapy, 110 (11%) had CR while 779 patients had PR, 27 (3%) did not have any response & 44 (4%) patients either lost or expired. At the 1st month end after radiotherapy, 181 (18%) patients had CR, 662 (67%) had PR, 47 (5%) had progressive disease, 43 (4%) no response & 58 patients were not available for observation. At 3rd month end 207 (21%) patients had CR while 602 (61%) had partial response. At 6th month end 335 patients had CR, 428 (43%) had PR, 85 (9%) had PD. At 1st year end 416 (42%) had CR, 641 (42%) PR & 95 patients were not available for observation. At 2nd year end 44% patients had CR while 43% had PR & 8% lost/expired. At 3rd year end 453 patients had CR, 386 had PR while 126 lost/expired. 4th year end observation had 448 CR, 349 PR while 189 were not available for follow up examination. At 5th year end 447 (45%) patients had CR, 92 (9%) PR, 452 (46%) lost/expired. Expected complications of CT & RT were managed accordingly. **Conclusion:** We achieved about 54% overall 5 years survival. Although it increases treatment duration. But patients can be mentally prepared for Radiotherapy. We achieved improved nutrition & good symptom relief.

PET scan guided consolidation interstitial brachytherapy in cervical carcinoma patients with clinically suspected residual disease after completion of treatment

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Aim: To evaluate the role of PET Scan guided consolidation interstitial brachytherapy (IBT) in cervical carcinoma patients with clinically suspected residual disease after 4 weeks of completion of concurrent chemoradiotherapy (CCRT). **Materials and Methods:** During the year 2006-2007, 23 cervical carcinoma patients having clinically suspected residual disease showing FDG uptake in the cervical/para cervical region after 4 weeks of completion of the standard course of CCRT were enrolled into the study. Patients with clinically evident or frank residual disease were excluded from this study. Before consolidation IBT, the standard CCRT consisted of whole pelvis EBRT with 40 Gy in 22 fractions over 4.5 weeks followed by 10 Gy in 5fractions over 1 week with midline shielding and then 3 sessions of weekly HDR intracavitary brachytherapy of 7 Gy each to Point A. Weekly chemotherapy (Cisplatin, 40 mg/sqm) was administered during the course of EBRT to all patients.

Four weeks later, PET/CT Scan was done on dedicated PET-CT scanner (SIEMENS, BIOGRAPH-64) using 5-10 mCi of intravenous FDG. The consolidation therapy consisted of a single session of high dose rate (HDR) IBT with a dose of 8-10 Gy. IBT needles were inserted through the perineum using Martinez Universal Perineal Interstitial Template under the guidance of Trans-rectal ultrasound (TRUS). Treatment planning was done on Nucletron planning system (PLATO) using the CT Scan images. IBT treatment was carried out on Microselectron HDR remote after loading unit and the perineal template was removed immediately after completing the treatment. All patients were followed up monthly till 6 months, every 2 months till 1 year and then every 3-6 months thereafter. **Results:** Follow up period ranged from 3-18 months (median 11 months). Of 23 patients, 15 (65%) had pelvic disease control, 6 had pelvic failure, 1 had para-aortic node recurrence and 1 lung metastases. One patient had hematuria during postoperative period, which stopped after 24 hours. Overall late toxicity (grade III-IV) was noticed in 3 (13%) patients. Of them, 2 had recto-vaginal fistula and 1 had sub acute intestinal obstruction. **Conclusion:** In patients with cervical carcinoma having residual disease on PET scan after 4 weeks of completion of CCRT, consolidation treatment with single fraction of 8 Gy HDR IBT provides effective pelvic control rate and acceptable complication rate. It may be further studied with a larger sample size.

Conformal radiotherapy for carcinoma cervix: Are we treating the right volumes?

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Aims: External beam radiotherapy portals for cervical cancer traditionally based on bony anatomy, as seen on X ray simulation, have been repeatedly demonstrated as inadequate. Conformal radiotherapy in cervical cancer requires contouring on axial CT slices, which have their own limitations and very often, we tend to err on the side of caution resulting in significantly larger treatment volumes. This study was meant to assess whether the potential dosimetric advantages of better target coverage are likely to be offset by the greater toxicities and poorer compliance associated with treating larger volumes. **Materials and Methods:** Five patients of carcinoma cervix stage IIIB underwent planning CT scan with IV contrast followed by contouring based on clinical findings for the primary and standard RTOG guidelines for the pelvic nodes. For each patient, two sets of plans, conventional and conformal, were generated using 4-field technique, with beams of appropriate energies (6 MV or 15 MV). The prescribed dose was 50 Gy/25# to the planning target volume (PTV) for conformal plans or to the isocentre for conventional plans. For the conformal plans, field shaping was done by multi-leaf collimators to conform to the PTV while for the conventional plans, traditional portals were used based only on the bony digitally reconstructed radiograph (DRR) with corner blocks in the AP/PA fields and beams were weighted equally. Subsequently, the volumes of interest were turned on in the treatment planning system for dosimetric analysis. Dose volume histograms of both sets of plans were generated to compare PTV coverage, and OAR sparing using the Wilcoxon matched pairs signed ranks test. **Results:** Target coverage was significantly improved using 3DCRT as compared to conventional RT (P = 0.043 for dose to 95% of PTV) but field sizes used were significantly larger (P = 0.043 for AP fields and P = 0.042 for lateral fields). On the other hand, dose homogeneity within the PTV was not significantly better with 3D CRT (P = 0.08 for average dose to the PTV). However, doses to the organs at risk (rectum, urinary bladder and small bowel) were not significantly different across the 2 arms. **Conclusion:** Three dimensional conformal radiotherapy gives significantly better PTV coverage, which may translate into better local control and survival. On the other hand, while it does require significantly larger field sizes, doses to the OARs are not significantly higher, hence the toxicity profile should not be worse compared to the conventional plans.

FDG PET/CT and carcinoma cervix

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Aim: To evaluate the role of FDG PET/CT in the management of carcinoma cervix. **Materials and Methods:** Retrospective data analysis of patients referred to our centre from January 2006 to December 2008 was done. Patients were injected intravenously with 10-15 mCi of F18 FDG after 4 hours of fasting and scanned per standard whole body protocol. Oral and intravenous contrast was given to patients. The scans were reported by a radiologist and PET physician jointly. Follow up was obtained where possible. **Results:** Data of 74 patients with cervical malignancy were analyzed.7/74 (9%) were referred for staging and 66/74 (89%) for restaging. 2/7 (28%) of the staged patients showed only the primary tumor. 5/7 (72%) of the staged patients showed the primary and metastases. 17/66 (26%) of the restaged patients were negative on PET/CT. 23/66 (34%) showed only metastases. 9/66 (14%) showed local tumor recurrence and metastases.4/66 (7%) showed only local tumor recurrence. 8/66 (12%) of the restaged patients showed metastases on CT alone and 1/66 (1%) showed a bulky cervix with no FDG uptake. 1/66 (1%) showed focal FDG uptake in the cervix with no obvious corresponding CT abnormality. 1/66 (1%) showed a mildly hypermetabolic right lung opacity suggestive of a benign etiology. 2/66 (2%) of the restaged patients showed breast and axillary nodal uptake. 1/74 (1%) patient was referred to monitor response to therapy who showed resolution of a previous node and decrease in metabolism of an abdominal wall metastasis. **Conclusion:** FDG PET/CT proved useful in the management of carcinoma cervix patients at our center and is to be considered part of the treatment protocol, particularly for restaging patients.

The role of concurrent chemoradiation versus radiotherapy in organ preservation in transitional bladder cancer: A randomized control trial

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Aims: The present study was done to assess the effectiveness of weekly cisplatin as concurrent chemoradiation in organ preservation in transitional bladder carcinoma. **Materials and Methods:** 24 patients with muscle invading transitional carcinoma of bladder, AJC stages Clinical T2-3, cNX, M0 were randomized into two groups. Initial evaluations included chest radiography, computed tomography (CT) scan of abdomen and pelvis. Patients with age <66years, KPS of 60 and above, normal liver function tests and complete haemogram, creatinine clearance >60ml/min were selected for the study. Patients were excluded if there was evidence of distant metastases, or prior pelvic irradiation, or if cisplatin was contraindicated. All patients underwent TURBT to confirm the histology and those with residual disease (either microscopic residual tumor or macroscopic residual tumor) received 3 cycles of combination chemotherapy of MVAC. Thereafter the patients of Arm A received 45 Gy of EBRT, 1.8 Gy in 25 fractions over 5 weeks with concomitant Cisplatin, 100 mg/m^2 in week 1 and week 4. The patients in Arm B received only EBRT 45 Gy, 1.8 Gy in 25 fractions over 5 weeks. All patients were re-evaluated with TURBT 3 weeks after completion of initial phase of treatment. Those with complete remission with no microscopic disease received additional 20 Gy of EBRT while patients with residual microscopic disease were subjected to radical cystectomy. **Results:** 75% (9/12) patients in Arm A receiving concomitant chemoradiation had complete remission whereas in Arm B it was 40%. One patient in arm A discontinued treatment during the radiation phase due to toxicity. Overall toxicity profiles in both groups were same with patients of arm A suffering from more EORTC Grade 2/3 lower GI-toxicity (8/12) than in patients of arm B (5/12). **Conclusion:** Patients receiving concomitant chemoradiation had a better chance of organ preservation (70%) than those receiving radiation only. However whether this translated into improved overall survival rate with improved locoregional control needs to evaluate

with follow up of patients.

Total peritoneal image guided IMRT in relapsed epithelial ovarian cancers: A feasibility study

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Introduction: Epithelial Ovarian Cancer (EOC) is a surface malignancy with predilection for transperitoneal and transcoelomic spread. Despite multiple surgeries and chemotherapy (standard treatment), 60-70% abdomino-pelvic recurrences has been reported. Various consolidative therapies including systemic or intra peritoneal chemotherapy, radiation therapy etc. have been tried. Radiation in the form of Whole Abdomen Radiotherapy (WAR), either as adjuvant treatment after maximal safe cytoreductive surgery or as salvage after chemotherapy failures has been tried in the past with limited success. Though effective, WAR, with conventional techniques has limitations. These limitations with newer radiation techniques like IMRT, IMAT, HT etc can be largely overcome. To evaluate the potential of HT for TP-IGIMRT in epithelial ovarian cancers, we undertook this feasibility study. **Materials and Methods:** Eight patients with relapsed epithelial ovarian cancers after 2nd line chemotherapy and with disease confined to abdomen/pelvis were invited. These patients were treated to whole abdominal radiation (WAR) with helical tomotherapy, comprising 25 Gy/25# to the abdomen with a simultaneous boost of 45 Gy/25# to the pelvis and gross disease. The CTV comprised the whole peritoneal cavity, pelvis and the paraaortic regions. The organs at risk were kidneys, liver, bone marrow, heart and lung with an aim to minimize doses to kidneys, bone marrow and liver. Toxicity was graded according to the CTC version 3. **Results:** The dosimetric outcome has been published elsewhere (JCAMP 2009). The treatment method resulted in excellent coverage of PTV with optimal sparing of OAR's. All patients completed their course of radiotherapy without any toxicity-related interruptions. Three patients developed Grade III hematological toxicity (Thrombocytopenia), which was managed conservatively, and 4 patients Grade II diarrheal GI toxicity. One patient had reversible Grade I nephrotoxicity, with deranged renal function tests. With a median follow-up of 8 months (4-15 months) so far, 1 patient has had recurrent ascites and peritoneal deposits, received oral etoposide, but died of disease at 4 months. Another patient has stable disease at para-aortic node (1.2 cm size) and is on oral CT at 10 months post treatment period. All other patients are disease free and on serial serum CA 125 level monitoring. **Conclusion:** Helical Tomotherapy based TP-IG IMRT with simultaneous pelvic/gross disease boost and optimal organ sparing is feasible and well tolerated for relapsed epithelial ovarian cancers. The acute toxicities are within acceptable limits. Further follow-up and validation in a larger cohort of patients is required.

Extended pelvic field therapy with or without chemotherapy in cancer uterine cervix-CMC experience

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Introduction: We have been treating patients who present this triad with elective para aortic irradiation since 1978. This retrospective study is an attempt to analyze the outcome and patterns of recurrence in these patients. **Materials and Methods:** Between January,1978 and December,2007 a total of 272 histologically proven cases of cancer uterine cervix were treated with extended pelvic field therapy in the Department of Radiotherapy, Christian Medical College, Ludhiana. Patients were staged according to FIGO staging. Ninety two percent patients were clinically stage III, while 4.8% and 3.7% were stage II and IV respectively. EBRT was delivered to whole pelvis and para aortic nodes to a dose of 40 Gy/20 fractions/4 weeks by AP: PA fields by a cobalt 60 Theratron 80 R unit. The pelvis was boosted with a dose of 10 Gy/5 fractions/1 week. Seventy seven percent patients received Radiotherapy alone while 23% patients received chemo radiotherapy using 5FU and Cisplatinum. Dose was then altered with 36 Gy/20 fractions/4 weeks, extended pelvic field and boost of 14 Gy/7 fractions over one and a half week to the pelvis. Three weeks after EBRT patients received intracavitary radiotherapy delivering a reference dose of 28-35 Gy to point A. Eighty eight patients received chemotherapy with the brachytherapy in the form of either 5FU alone, 5FU with CDDP or CDDP alone. Follow up ranged from 6 months to 180 months with median follow up of 12 months. Complications were graded according to WHO grading criteria. **Results:** Pain relief was seen in 95.24% patients and only 7.35% did not experience any pain relief. Pain relief was seen by the tenth day in 55.6% patients, while 30.9% patient's relief by 14-15 days and 10.3% patients had relief of pain by the twentieth day of commencing EBRT. At end of follow up, 79.77% were locally well. Fifty five patients developed loco regional failure. Nodal recurrence was seen in 5.5% only and 10.3% patients developed metastatic disease. Five patients developed second malignancies. Twenty seven patients survived more than five years. **Conclusion:** The triad of sciatic pain, hydronephrosis and leg edema is a reliable clinical indicator of para aortic lymph node involvement and can be used to pinpoint patients who would benefit from para aortic irradiation. Extended pelvic field therapy is well tolerated with or without chemotherapy and provides adequate control in the dose schedule used with minimal morbidity. It provides adequate and quick pain relief and for those few long term survivors, the benefit is great.

Outcome of patients with post - orchidectomy stage I seminoma treated between 1990-1998: A retrospective analysis

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Aim: The outcome of patients with Stage I Seminoma is excellent. Post orchidectomy prophylactic radiation to para-aortic and pelvic nodal region, adjuvant chemotherapy or surveillance has been tried with no definite consensus. With an aim to analyze and document the outcome we undertook a retrospective analysis of patients treated over 9 years. **Materials and Methods:** The treatment charts of patients with Stage I Seminoma treated between January 1990 and December 1998 were retrospectively reviewed. Patient and tumor characteristics, stage, treatment details including type of surgery, adjuvant treatment, radiation portals, doses, technique etc. relapse rates, any late toxicities, or occurrence of second primary were noted. Royal Marsden Staging System was utilised. Survival outcomes and detailed analysis was done using SPSS 14.0 Software. **Results:** A total of 137 patients with Stage I Seminoma were evaluable. With a mean age of 36 years (median age 35 range 20-68 years), 72 patients (52.6%) had right sided, 63 patients (46%) left sided and 2 patients had bilateral seminoma respectively. Eleven (8%) patients had history of mal-descendent testis. One hundred and twenty one patients (88%) were referred after orchidectomy, 9 (6.6%) patients after adjuvant radiation for further treatment and 7 patients underwent surgery at our institution. One hundred and two patients (74%) patients had undergone inguinal orchidectomy and 35 (26%) underwent scrotal orchidectomy. Out of 137 patients, 41 (30%) patients did not receive any further treatment, 96 (70%) patients received prophylactic radiotherapy to para-aortic and pelvic nodes. Mean radiotherapy dose was 30 Gy (Median:30 Gy; range: 5.4-54 Gy). For 41 patients under observation, with a median follow-up 20 months (Mean: 41.3; 8-156 months), 9 patients had nodal relapse with 7 in retroperitoneal nodes and 2 patients in inguinal nodes. Of these, 7 patients received BEP chemotherapy and 2 patients Chemo-radiation. Four patients had complete remission while remaining 5 patients had partial response. Four patients died of disease while 2 others died of unrelated cause/unknown. For patients who underwent prophylactic radiation, with a median follow-up of 33 months (mean 42 months; 9-143months), 6 patients relapsed (RP nodal disease in 5 patients and

distant metastasis (lung) in 1 patient). All these patients received BEP chemotherapy. One had complete response and remaining 5 patients had partial response and 4 patients died of disease. Five years DFS and OS was 62% and 65% for patients with surgery alone and 90 and 92% for patients undergoing prophylactic radiation respectively. Various prognostic factors were also evaluated. **Conclusion:** Patients kept under observation after orchidectomy had higher relapse rates, while Stage I Seminoma treated with prophylactic radiation to para-aortic and pelvic region had better outcome. However, this retrospective data lacks reporting on late toxicities and quality of life issues.

Randomised controlled study to evaluate the association of human papilloma virus with carcinoma cervix & to study the effect of external radiotherapy along with brachytherapy on HPV titre in carcinoma cervix

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Aim: The main aim of this study is to evaluate the association of Human papilloma virus with carcinoma cervix and to analyse the effect of radiotherapy on HPV titre before and after radiotherapy. **Materials and Methods:** 71 Patients of locally advanced carcinoma cervix were included in this study. Pre-treatment cervical biopsies were taken & HPV DNA typing & estimation of titre was done. Patients completed the full course of Radiotherapy from Aug-2008 to May-2009. All Patients recieved EBRT in dose of 4600 CGY/23 fr in 4.5 wks to pelvis with Co-60 (780E). This was followed by intracavitory Radiotherapy in dose of 650 CGY weekly for 3 weeks. After 6 months of completion of Radiotherapy 38 patients were on follow up in which HPV typing was done & titre was measured by real time PCR in pap smear specimen. Pre Radiotherapy & Post Radiotherapy HPV titres were compa. **Results:** HPV -16 were +ve in 48 patients (67.60%) whereas HPV-18 was found to be +ve in 19 patients (26.76%) & combined HPV (16 & 18) +ve in 16 patients (22.5%) in total 71 patients. 38 patients were on follow up after Radical Radiotherapy. HPV titre was measured before RT & after 6 months of completion of RT and it has been found that there is significant decrease in the titre after RT. The HPV titre ranged from 0.00145 to 7090 before RT & from 0.0064 to 71.7 in ng/ml after 6 months of completion of RT with *P* Value < 0.001. HPV titre is 0 in 7 patients after t/t. The clinical, histopathological & cytological correlation of HPV titre is also done. **Conclusion:** Radiotherapy is the most effective mode of treatment for cervical cancer. It is effective in decreasing the HPV titre. A reduction in these titres of their baseline values at the end of RT is also associated with better survival outcomes. Long term disease free survival is under assessment.

Head and Neck Cancers

A comparative study between intracavitary brachytherapy boost versus ebrt boost in early stage nasopharyngeal cancer: An institutional study of 15 cases

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Aims: Cancers of nasopharynx are different from other cancers of head and neck region. Though it is a relatively uncommon cancer in India but in our institution fair number of cases of nasopharyngeal cancer is attended. The principle modality of treatment for this disease is radiation therapy with concomitant chemotherapy. During radiation treatment boost to the local site is necessary which can be delivered by either external beam or intracavitary brachytherapy. But comparative data regarding outcome with the different boost technique is insufficient. We conducted this retrospective analysis to assess the difference of outcome (response and toxicity) according to the method of boost. **Materials and Methods:** We selected 15 cases of histologically proven epidermoid cancer of Nasopharynx treated at our department between May 2005 and May 2007. As per the institutional policy all cases were of good performance status and devoid of comorbid illness. CECT scan was done in all the cases after proper immobilization in treatment position. Treatment planning was done in computerized treatment planning system. In the initial phase of treatment all the cases were treated with EBRT at the dose of 56 Gy/28#/5.5wks. Cord sparing was done after 50 Gy. Weekly concomitant Cisplatin was given at the dose of 100 mg/m^2. In the second phase 8 patients received EBRT boost of 14 Gy/7#/1.5weeks. Treatment was given with Cobalt-60 machine. The other group of 7 patients was prescribed HDR, ICBT boost. The nasopharyngeal brachytherapy applicator was introduced after application of Lignocaine nasal spray and positioned in nasopharynx. Dose prescribed was 5 Gy/#/day for 2 consecutive days.(Eq$D_2$14 = Gy) to.5 cm beyond mucosal surface. All the cases were followed up regularly for 2yrs at our OPD. **Results:** None of the cases developed locoregional recurrence in both arms. Six out of the 8 cases developed hearing impairment and 1 patient developed pain in temporomandibular joint in EBRT boost arm. In ICBT boost arm 1 of the 7 cases developed hearing impairment Analysis done by two tailed Fisher's test showed hearing impairment was significantly higher (*P* = 0.04) in EBRT boost arm. **Conclusion:** Brachytherapy boost in the management of nasopharyngeal cancer causes less toxicity in comparison to EBRT boost. Further studies, preferably prospective are needed to asses the significance of this difference.

Neoadjuvant chemotherapy in head and neck cancer followed by concomitant chemoradiation with carboplatin versus radiation therapy alone

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Aims: To evaluate the efficacy and safety of neoadjuvant chemotherapy with docetaxel, carboplatin and 5-FU followed by radiation therapy with or without concomitant carboplatin in locally advanced head and neck cancer. **Materials and Methods:** The study was conducted on 60 treatment naïve, patients of squamous cell carcinoma of head and neck. The sixty patients were randomly divided in two groups of thirty each. All the patients were administered neoadjuvant chemotherapy with Docetaxel, Carboplatin and 5-FU for a minimum 3 cycles (3-weekly cycles, range 3-6 cycles, median 4 cycles). Docetaxel was administered in a dose of 75 mg/m^2 IV infusion over 1 hour after mandatory premedication. Carboplatin was administered in a dose of 300 mg/m^2 IV infusion over 30 minutes and 5-FU in a dose of 650 mg/m^2 given IV bolus. All the patients were planned for radical radiation therapy 64 Gy/32F/6.2weeks (2 Gy/F and 5F/week). The study group patients were administered concomitant Carboplatin 300 mg/m^2 on D1, D22 and D43 of radiation therapy schedule. **Results:** The patient parameters of age, sex, primary site, stage and KPS scales were closely matched in the two groups. The site of the disease was Base of tongue - 24, Tonsil - 9, Pyriform fossa - 4, Hypopharynx-3, Larynx-12, Floor of mouth - 1 and Soft palate - 7. The stage of the disease was TNM Stage III-26 and Stage IV- 34. The overall local control in study and control group respectively was as follows: Overall response rate after neoadjuvant chemotherapy was - 24/30 (80%) vs 23/30 (76.7%) with Complete Response (CR) in 9/30 (30%) vs 10/30 (33.3%) and Partial Response (PR) in 15/30 (50%) vs 13/30 (43.4%). Overall response rate after completing radical treatment was 28/30 (93.3%) vs 25/30 (83.3%) with Complete Response (CR) in 22/30 (73.3%) vs 18/30 (60%) and Partial Response (PR) in 6/30 (20%) vs 7/30 (23.3%). The patients were followed up for a median period of eight months (range 6-20 months). Disease status at last follow up was as follows: No evidence of disease (NED)-14/30 (46.7%) vs 12/30 (40%), Residual disease (RD)-8/30 (26.7%) vs 12/30 (40%), Recurrent disease (REC)-8/30 (26.7%) vs 6/30 (20%). Hematologic toxicity after neoadjuvant chemotherapy was comparable in both the study and control groups. Anemia grade 3 & 4-5/30 (16.7%) Vs 5/30 (16.7%), Neutropenia grade 3 & 4-9/30 (30%) vs 8/30 (26.7%) and Febrile Neutropenia-4/30 (13.3%) vs 3/30 (10%). Significant

non hematologic toxicity were Nausea & Vomiting-14/30 (46.7%) vs 15/30 (50%) and diarrhea-15/30 (50%) vs 16/30 (53.3%). RTOG grade 3 & 4 acute radiation mucositis was observed in 22/30 (73.3%) vs 15/30 (50%) in study and control groups respectively. Thus, there was increased acute radiation toxicity in chemoradiation arm. **Conclusion:** The present study has shown that neoadjuvant chemotherapy with Docetaxel, Carboplatin and 5-FU is feasible and effective in locally advanced head and neck cancer. The results are better if it is followed by concomitant chemoradiation rather than radiation therapy alone, though the concomitant chemoradiation is more toxic. There was improved locoregional control with CR-73.3% vs 60%, (P = 0.14) in chemoradiation and radiation alone group respectively. Grade 3 & 4 acute radiation toxicity was 73% vs 50% (P = 0.11) in chemoradiation and radiation alone groups respectively, but were manageable. There was a trend towards better disease free survival at last follow up with chemoradiation 47% as compared to radiation alone 40%.

Evaluation of fractionation in form of six fractions per week radiotherapy schedules in locally advanced head and neck cancers

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Aim: To evaluate the feasibility and efficacy of six fractions per week radiation schedules in terms of loco-regional control of the tumor and radiation induced side effects in locally advanced head and neck cancer patients. **Materials and Methods:** One hundred and twenty seven previously untreated, histopathologically proven, stage III and stage IV, squamous cell carcinoma of locally advanced head and neck carcinoma patients were included in the study. All patients were given radical radiotherapy. The patients were taken radiotherapy to a dose of 66 Gy over 33 fractions in 5.3 weeks. All Patients were evaluated for in term of response, toxicity and survival. **Results:** One hundred and twenty seven patients were available for final evaluation. Median age of presentation of patients was 55 years. Forty eight percent of patients had stage III disease. Skin and mucosal toxicity were most common side effect observed during treatment. Complete response observed in 77% Patients 21% showed partial response at end of treatment. **Conclusion:** Six fractions per week radiation schedule had produce superior tumor control, but at the same time produced higher but acceptable mucosal toxicity. In view of the encouraging local control and acceptable radiation toxicity this trial continues to enroll more patients, supportive care can be used effectively to overcome toxicity associated with this trial.

Role of concomitant geftinib and radiotherapy in locally advanced squamous cell carcinoma of head and neck

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Aim: Squamous cell carcinoma of the head and neck remains a challenging clinical problem despite available standard treatment modalities. Targeted therapies are one of the latest innovative trends in cancer therapy. The aim of this study is to establish the safety and toxicity profile of daily geftinib along with radiation in previously untreated patients with locally advanced squamous cell carcinoma of head and neck. End points for the study included - tumor response, acute toxicity to radiotherapy or chemoradiotherapy, total disease control and survival. **Materials and Methods:** Our study comprised of 100 locoregionally advanced, histopathologically proven squamous cell carcinoma of head and neck. 53% were of stage IV and 47% were of stage III. Median age was of 50 years. The study was divided in 2 arms comprising of 50 patients each. Arm A received 250 mg/day of oral geftinib along with conventional external beam radiotherapy. Arm B received external beam radiotherapy only. Dose of EBRT was 66 Gy/33#, 5#/week in both arms. All patients were evaluated weekly and instances of toxicity of both RT & CT were graded as per RTOG toxicity grading system. Response in treatment was evaluated three months following completion of treatment. **Results:** At 3 months after completion of radiotherapy, the response rates were CR, PR & NR as 42%, 31% and 27% respectively in arm A and as 30%, 22% & 48% respectively in arm B. Grade II and III mucositis and skin reactions were observed in all patients but were manageable. **Conclusions:** Geftinib at a dosage of 250 mg/day is not associated with hematological, neurological or nephrological toxicities commonly seen with traditional cytotoxic drugs. The short term study reveals concomitant chemoirradiation with geftinib was feasible treatment with tolerable side effects, which can improve locoregional control in locally advanced squamous cell carcinoma of head and neck. Patient's nutritional status and growth pattern of tumor also affects the response rate. However the median follow up was only upto 7 months and therefore the study is still continued for long term assessment.

Randomized controlled, comparative study of conventional EBRT alone vs. EBRT plus HDR brachytherapy in head and neck cancers

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Aim and Objective: Radiation toxicity is the sole barrier to dose escalation by External Beam Radiation therapy and can be reduced by addition of brachytherapy as a boost. This study was conducted to compare and evaluate feasibility, efficacy, safety profile and the results of EBRT plus brachytherapy with only EBRT in squamous cell carcinoma of head and neck (SCCHN). **Materials and Methods:** Prospective study was conducted on 84 proven cases of SCCHN between May 2007 to May 2009. Patients were randomly selected and divided in to Trial and Control arms. Pts. in Trial arm received 46-50 Gy/23-25#/4.5-5 wks of conventional EBRT followed by 2-3 # of HDR brachytherapy 650cGy each after 7- 15 days of EBRT using Ir-192 as source. Brachytherapy done by interstial tube and button technique with rigid needles or plastic tubes, plastic loop technique, and intracavitary applicators. Patient in Control arm were received only conventional EBRT (Co-60) of 60-70 Gy/30-35 #/6-7wks. **Results:** Out of 84 patients taken in study, only 60 had completed the treatment, 24 (40%) stage IV, 21 (35%) stage III, 12 (20%) stage II, and 3 (5%) stage I. 59 (98.33%) cases of oral cavity, only 1 (1.67%) was of nasopharynx. In a median follow up of 2yrs, it was found that in trial arm 22 (73.33%) patients had locoregional control with no distant metastasis, 6 (20%) had residual disease and 2 (6.67%) had recurrence, compared to that of 10 (33.33%), 17 (56.67%) and 3 (10%) in control arm respectively (P-value < 0.001). On comparing grade IV acute toxicity, in trial arm pain 5 (16.67%), mucositis 15 (50%), skin reaction 5 (16.67%), alteration in taste 0% and dysphasia 0%, whereas in Control arm, it were 16 (53.33%), 26 (86.66%), 2 (6.67%), 8 (26.67%), 7 (23.33%) respectively. Among the late toxicities, in trial arm skin changes [hyper- pigmentation-6 (20%) and vitiligo-18 (60%)] 24 (80%), subcutaneous indurations and fibrosis 17 (56.67%), dryness of mouth 25 (83%). Whereas in control arm it were 29 (96.67%), 28 (93.33%), 30 (100%) respectively. No patient in both the arms had osteoradionecrosis. Two patients in trial arm developed necrosis of the soft tissue and were undergone surgery. No patient in control arm had vitiligo formation inspite there were only hyper- pigmentation of the skin. **Conclusion:** EBRT plus HDR brachytherapy has better local control, less recurrence rate and less acute toxicities compared to EBRT alone. However long term follow is needed to assess late toxicities, DFS and OS.

A comparative analysis of concomitant boost radiotherapy vs. Conventional fractionated radiation in carcinoma larynx

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Introduction: The incidence of laryngeal cancer is 1-2% of all malignancies. However a considerable body of literature on it reflects the perceived importance of this cancer relative to its potential impact on people's communication skills. Various scheme

of altered fractionation schedule like hyperfractionation & accelerated fractionation develop to compare with conventional fractionated schedule aimed at better laryngeal preservation. The concomitant boost technique had been tried keeping in mind the radiobiological aspects of accelerated fractionation radiotherapy which gives beneficial results by decreasing the number of clonogenic cells to considerable extent and without doing much harm to normal cells. **Aim of the Study:** To compare the feasibility, tolerability, effectiveness of concomitant boost RT over conventional RT in treatment of carcinoma larynx. **Materials and Methods:** 50 patients of histologically proven squamous cell carcinoma of the larynx in Stage I - IV without distant metastasis with good performance status (KPS>60) and no significant co-morbidities were included in the study. All the patients were stratified into two arms, **Control Arm A**-Patients received conventional External Beam Radiotherapy (EBRT) of dose 60 Gy in 30#, 2 Gy per fraction, 5# per week for 6 weeks. **Study Arm B**-Conventional EBRT of dose 60 Gy/6 weeks + concomitant boost RT of dose 1.2 Gy per #, 5#/week × 2 weeks during last 2 weeks of the 6 week period with total dose of 72 Gy. **Results:** All patients in Arm A (n = 25) and Arm B (n = 25) received complete treatment as per defined protocol. Response assessment done after 6 weeks of completion of treatment. Complete response (CR) seen in the study was 84% vs. 68%, the locoregional control after a median follow up of 12 months was 68% vs. 44% and the 2 year DFS was 67% vs 43% in study arm (CBT) vs. control arm (Conv. EBRT) respectively. Acute toxicity including mucositis, dysphagia, dermatitis were increased but tolerable in the study arm but the significant late morbidity (persistent laryngeal edema) was comparable in both arms. **Conclusion:** We conclude that the the response to RT, locoregional control, 2 year DFS of CBT is better than Conv. EBRT in carcinoma of larynx with manageable local toxicities. Further analysis and follow-up are needed to evaluate if the benefit will translate into prolonged survival.

Reirradiation in head and neck cancer in indian patients: AIIMS experience

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Aims: To assess feasibility of reirradiation in head and neck cancer patients. **Materials and Methods:** We performed retrospective analysis of 18 patients of recurrent or second head and neck cancer (HNC) who underwent reirradiation either alone or as a component of multimodality therapy at our center from 2006-2008. **Results:** The primary cancer site was oral cavity- 5, oropharynx-3, hypopharynx-4, larynx-4; nasopharynx-1 and parotid gland-1. Primary treatment comprised of radiotherapy alone in 7 patients, radiotherapy following surgery in 9 patients and chemo-radiotherapy in 2 patients. Initial radiation dose ranged from 56 Gy-70 Gy in conventional fractionation, postoperative patients received dose of 56-64 Gy while radically treated received 66-70 Gy. 14 patients were treated in telecobalt unit and 4 patients in linear accelerator. Patients treated in telecobalt were planned by 2D technique using two lateral radiation portals and planned in simulator. Recurrence was in site of primary in 12 patients (66%), while it was in different site in 6 (33%) patients. Site of recurrent/new primary was oral cavity- 7, oropharynx - 1; hypo pharynx-3, larynx -4 parotid-1, nasopharynx-1 and nodal only-1. Treatment for recurrence comprised of reirradiation only -13 patients, surgery followed by reirradiation-2 patients and reirradiation with concurrent chemotherapy -3 patients. The median interval between primary and reirradiation was 3.8 years (range 1-38yrs). Median RT dose was 45 Gy in 25#. Median duration of reirradiation was 39 days (35-44 days). Median follow up duration was 3.7 months (range 1.3-16.8 mth). In last follow up 7 (38%) patients had no evidence of disease, 8 (44%) were alive with disease and 3 (16%) were lost to follow up. CT based planning was done for reirradiation in all cases. 15 patients were treated in linear accelerator while 3 in telecobalt unit. In most cases, the target volume for re-irradiation was confined to the gross tumor volume only. Median volume of treated CTV was 97.6 cc (33-390 cc) and PTV 153.7 cc (68.5-643 cc). Maximum spinal cord dose varied from 181 cGy to 4972cGy. Median cumulative radiation dose was 109 Gy (range 101-120 Gy). All patients completed reirradiation and there was no treatment related mortality. **Conclusions:** Repeat radiation is feasible in carefully selected recurrent HNC patients. Reirradiation to recurrent gross tumor volume with dose of 45 Gy is well tolerated.

Randomized controlled comparative study of concurrent vinorelbine & radiotherapy versus conventional radiotherapy in locality advanced had & neck cancer

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Aim: The aim of this study is to compare the efficacy & toxicity in patients treated with concurrent Vinorelbine & radiotherapy versus Radiotherapy alone in patients with locally advanced (Stage III and state IV a) squamous cell carcinoma of the head and neck (SCCHN). **Materials and Methods:** From August 2005 to July 2006, 60 patients of locally advanced head and neck cancer patients have been randomized to receive concurrent Vinorelbine and Radiotherapy (Trial-Arm) versus conventional Rdiotherapy (control-Arm). Out of which 30 patients were in Trial Arm and 30 patients were in Control Arm. Patient in Trial Arm received Vinorelibine 20 mg/m^2 over 6-10 min infusion minimum 2 hour before E.B.R.T. on Day -1, 8, 15, 22, 29 while patients in Control Arm received only E.B.R.T. i.e. without Vionorelbine. Both group of patients received radiotherapy 60-70 Gy to loco regional site at equal dose rate 2 Gy/fraction/day, 5 fraction/week, over 6-7 week by Co-60 (780-E). **Results:** This study comprising of 30 patients in each of the experimental and Control Arm. Response after completion of treatment in Trial Arm 73.3% patient had complete response while 26.7% patients had a partial response, and in Control Arm 40% patients had complete response while 58.3% patients had a partial response and 1.7% patients had no response with *P*-value < 0.001. In both arms stage III patients show better response than stage IVa. In both stages (III and IVa) Trial Arm patients have better response (for III pt.-82.2% and for IVa pt. 42.8%) over Control Arm patients (for III pt. 57.2% and for IVa pt: 22.3%) with *P* value < 0.001. The median duration of follow up was 18 month in each group (range 6-32 month). In Trial Arm 12 (40%) patients were come for follow up, of which 9 (30%) patients were free of disease, while in Control Arm 8 (26.7%) patients come for follow up, of which 3 (10%) patients were free of disease. The mucosities, dysphagia and hematogical toxicities were higher in patient treated with chemo-radiation (Trial -Arm) than seen in patients treated with Radiotherapy alone (Control-Arm). **Conclusion:** It is conclude that Vinorelbine with Radiation is feasible & well tolerated in patients with locally advanced squamous cell carcinoma of the head & neck (SCCHN) with better response as compared to Radiation alone. However the toxicities are higher in Vinorelbine arm although all patients were managed conservatively & well. Further studies with larger number of patients and longer periods of follow up are essential for definite conclusion.

Others

Survey of undergraduate medical students on their understanding and attitude towards the discipline of radiation oncology in India

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Aim: The subject of radiation oncology (RO) in India is still considered a low priority subject. We decided to conduct a survey of undergraduate (UG) medical students to study the awareness, understanding and their attitude towards the subject of RO. **Materials and Methods:** A simple 12 point questionnaire was sent by E-mail, post to the UG students of various medical schools in India who have been introduced to the clinical subjects (MBBS 3rd year onwards). The data provided by the respondents was analyzed statistically to find out the objectives. **Results:** A total of 155 respondents have sent their responses. Twenty eight of them (18%) opine that RO is not a part of UG curriculum at their institute. About 84% think that not more than 10 theory lectures/practical classes are assigned to RO during the entire UG period. About 1/3rd respondents reply that there are no separate clinical postings for RO since these are merged with radiology. Only 14% respondents are aware that RO posting is mandatory during rotating internship. According to 54% responses, RO is still a low priority subject in the PG setting and 70% think that inadequate exposure at UG level and lack of awareness about current prospects of RO are the main reasons for this. **Conclusion:** UG medical students in India have poor exposure and awareness of the subject of RO during UG teaching. The Medical Council of India needs to modify the UG curriculum so as to enhance the awareness and exposure of this specialty.

Training the trainees in Radiation oncology through telemedicine: A 2 year audit

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Introduction: The estimated new cancer patient load in the state of Uttar Pradesh is 1-1.2 lakh per year out of which approximately two thirds require treatment by a radiation oncologist. Radiation oncologists: cancer patient ratio in this state is 1:2000 as compared to the recommended 1:250. To compound this problem is the existing infrastructure of radiation oncology departments in the state which is suboptimal for teaching, training of resident doctors and treatment in most centers barring a few. Radiation oncology is entirely dependant on technology and keeping abreast of the changing technology is essential to enhance skills as a radiation oncologist. With a view to bridge some gap in the socio-demographics stated above and enhancement of training of residents inducted into the radiation oncology MD program in the state we established a telemedicine facility in our department with linkage to a medical college in the city in the first phase of this DST (Department of Science and Technology) project. We present the design, implementation and a two year audit of our teleeducation activities. **Materials and Methods:** Site preparation, installation of equipments at both nodes was completed along with integration of ISDN telecommunication media in the month of February 2007. A hardware based videoconferencing system was setup for this project. After the technical testing of telecommunication with ISDN lines, regular videoconferencing sessions were started. Morning academic sessions in our department were shared via a virtual classroom with the remote node. All the events taking place in the two telemedicine nodes were recorded in the Log book maintained on day to day basis. **Results:** A total number of 201 sessions were planned to be transmitted from the expert end from April 2007 to May 2009. Amongst this a total of 119 sessions could be transmitted and the rest had to be cancelled due to either technical problems. These sessions comprised of clinical topics (59), medical physics (37) and radiobiology (11). Feedback regarding the content of the program was satisfactory as far as training of the residents was concerned. **Conclusions:** Distance education in radiation oncology is an important tool for training of the residents. We were able to facilitate teaching and training of residents at the remote center as envisaged.

Physics and Radiation Technology

Dosimetric study of tomotherapy based IMRT challenging high dose rate brachytherapy in cervical cancer

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Aim: Dosimetric evaluation of helical tomotherapy based IMRT to achieve dose distribution of high dose rate brachytherpay in cervical cancer. **Materials and Methods:** The CT dataset and final plan of three tandem and ovoid high dose rate (HDR) Applications were utilized for this dosimetric study. The 200%, 150%, 100%, 75%, 50% and 25% isodose lines and OAR's namely rectum, bladder and sigmoid were contoured on each slice on Oncentra TPS. The data set was transferred to Tomotherapy TPS. The planning objectives were to achieve similar dose gradient as seen in brachytherapy planning. A dose of 7 Gy to point A normalized at 100% was duplicated in Tomoplans. Plan evaluation and comparison was done using various dose parameters like D90, D100, dmedian, low dose volumes and other indices for target and DVH parameters of 0.1 cc,1 cc and 2 cc volume doses for OAR's. **Results:** The median (+SD) D90 for 100% isodose volume, which happens to be the prescribed volume for brachytherapy and tomotherapy were 7.38 (+0.02), and 8.21 (+0.04), respectively (*P* value = 0.01). Similarly, the median (+S.D) for 75% and150% isodose volume for brachytherapy and tomotherapy were 5.58 (+0.36), 11.04 (+0.06) and 6.46 (+0.15), 11.2 (+1.16) respectively. For OAR, median D2 cc (+SD) of rectum, bladder and sigmoid for brachytherapy and tomotherapy are 3.2 (+0.47), 8.9 (+3.07), 5.5 (+0.77) and 3.03 (+0.65), 9.70 (+2.5), 5.9 (+0.3) respectively. The median V2 Gy, which was taken as a surrogate marker for integral dose, was 568 cc (+22.51) and 2093 cc (+202.6) for brachytherapy and tomotherapy respectively (*P* value = 0.01). Various indices are also being evaluated. **Conclusion:** Tomotherapy Based IMRT achieved significantly better dose distribution for 100% dose levels achieved with brachytherapy. It also showed a good agreement between brachytherapy and tomotherapy plans for 75% and 150% isodose regions. However, low doses regions (V2 Gy) were significantly higher with tomotherapy based IMRT plan.

To evaluate patient set-up errors using cone beam computed tomography and two-dimensional orthogonal electronic portal imaging device and killo voltage X-ray in patient undergoing intensity-modulated radiotherapy of various site

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Aim: To evaluate patient set-up errors using cone beam computed tomography (CBCT) and two-dimensional (2D) orthogonal electronic portal imaging device (EPID) and killo voltage (KV) X-ray in patient undergoing Intensity-modulated radiotherapy (IMRT) of various site. **Materials and Methods:** 12 patients undergoing IMRT at various sites (5 abdominal and 7 pelvis) were enrolled for this study. All patients were immobilized using thermoplastic mask on carbon fiber base plate. After precise alignment of the patient onto the linac isocenter with the guidance of in-room laser and setup marks on thermoplastic, pre-treatment images were acquired by CBCT, MV EPID or KV orthogonal radiograph before each fraction. CBCT images were co-registered with reference planning CT datasets while orthogonal MV EPID or KV X-rays images were compared with reference digitally reconstructed radiograph (DRR). A total of 320 image sets were evaluated to estimate mean, systematic setup error (Sigma), and random setup error (sigma). **Results:** The mean systematic errors in the supero-inferior, lateral and antero-posterior directions were 0.04, 0.10, 0.08 cm for pelvis and 0.05, 0.04, 0.05 cm for abdomen respectively. Whereas the standard deviation (Sigma) were 0.12, 0.17, 0.17 cm for pelvis 0.21, 0.21, 0.19 cm for abdomen respectively. Root mean square of random errors (sigma) were 0.28, 0.20, 0.57 and 0.24, 0.17, 0.35 cm respectively. The Mean rotational systematic errors were 0.1° and 0.2° for pelvis and abdomen. The PTV margins using Stroom's and Van Herk's formula were estimated. **Conclusions:** The set-up error data helps us in generating institution based PTV margin for various sites. are followed in our department are based on the tolerance limit of set up inaccuracies of

our IGRT (Triology) system based on Stroom's and Vna Herk's formulae.

Analysis of inter fractional setup errors during radiotherapy for head and neck tumors to compute an appropriate PTV margin

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Aims and Objectives: Analysis of inter fractional setup errors occurring during radiotherapy for head and neck cancers for computation of an appropriate PTV margin. **Materials and Methods:** Fourteen patients with head and neck cancers to be treated with a curative intent by 3D-CRT/IMRT technique were recruited into the study. Thermoplastic mould was used for immobilization of all the patients. The patients were planned after acquiring the CT scans in treatment planning position using CT simulation. Treatment planning was done on the Precise PLAN Treatment Planning System (TPS) (version 2.16; Elekta) and Digitally Reconstructed Radiographs (DRR) were generated from the CT simulation data. After the patient set up on the treatment couch, two orthogonal films- lateral and antero-posterior- of 15x15 cm^2 were taken for verification using Electronic Portal Imaging Device (EPID). The images were matched with the DRR's on the iView GT (version 10.03; Elekta) portal vision software using the *'split technique'* for the determination of set up errors with respect to the table coordinates. Set-up corrections were attempted only if the errors exceeded 3 mm. Verification of the treatment set up was carried out every day for the first week, and on a weekly basis thereafter till the completion of treatment. To begin with, the systematic error (SE) and the standard deviation of random error (RE) were determined separately for each patient for the antero-posterior (AP), medio-lateral (ML) and cranio-caudal (CC) displacements. From these data, the Standard deviation of the group systematic error ($\sum$) and the root mean square of the standard deviations of random errors of all patients (σ) were derived. Calculation of the required PTV margin was done as per the recommendations of Stroom *et al*, where consideration is given for both the systematic and the random errors, with the following formula: CTV-PTV margin = 2.0 $\sum$ + 0.7 σ. **Results:** A total of 41 corrections had to be made among all the patients during their entire treatment course, with one patient requiring 6 corrections, and two patients requiring only one correction during their course of treatment. Nine out of 14 patients had to undergo set up adjustments on the first day of treatment. All the patients undergoing corrections on the first day were found to have an error component in the Cranio-caudal direction. The magnitude of deviations was also found to be the maximum in cranio-caudal direction (range: 0.5 to 12.6 mm). The Standard deviation of the group systematic error in AP, ML and CC directions were 1.17 mm, 0.98 mm and 0.89 mm, respectively. Similarly, the root mean squares of the standard deviations of random errors in the whole group were 1.73 mm, 1.92 mm and 2.47 mm in the AP, ML and CC directions. In the first week of the treatment, the systematic errors were predictably higher, with $\sum 1^{st}$ week = 1.45 mm, 1.76 mm and 1.24 mm for the AP, ML and CC directions. However, the random errors continued to occur at a similar degree throughout the treatment, the σ 1^{st} week being 1.80, 1.84 and 3.49 mm in AP, ML and CC directions, respectively. Applying the formula recommended by Stroom *et al*, the PTV margin required to adequately cover the CTV was calculated to be 3.6 mm in the Antero-posterior, 3.3 mm in the lateral and 3.5 mm in the cranio-caudal directions, respectively. **Conclusion:** Systematic errors contribute to the set up error significantly, and must be taken into consideration in determining the set up margin. Systematic errors also tend to occur more during the first week of radiotherapy, though they continue to occur to a smaller extent during the entire course of treatment. The margin required to adequately cover the CTV without any under-dosage for radiotherapy in head and neck malignancies at our centre was found to be 3.6 mm.

Hypofractionated SBRT for prostate cancer with cyberknife: Protocol comparison and clinical observation

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Purpose: To compare Virtual HDR plans and homogeneous plans for prostate treatment using the CyberKnife® Robotic Radiosurgery System and the MultiPlan® Treatment Planning System and to report on clinical observations such as PSA response, toxicity evaluation and quality of life assessment. **Introduction:** The CyberKnife Robotic Radiosurgery System is capable of delivering non co-planar beams anywhere in the body with sub-millimeter accuracy. This unique feature of CyberKnife makes it possible to plan and deliver HDR-like dose distribution in the prostate and simultaneously sparing critical organs. The recent **Introduction:**of the sequential optimization and variable aperture Iris collimator helped in a shorter treatment time. At the CyberKnife facilities at Western Cancer Center, prostates are treated following a Virtual HDR dose plan. Also because of the unique nature of CyberKnife, prostates can be treated with a homogeneous dose distribution with CyberKnife as well. In this study we compare these two types of plans. Patients treated in this facility are follow-up up to 2 years. Early clinical observations of these patients will be presented. **Materials and Methods:** In the protocol comparison study we choose 15 prostate patients treated following the Virtual HDR dose protocol. Homogeneous plans were created for these patients following multi-institution prostate homogeneous dose protocol. In both protocols, the GTV is only the prostate gland. The proximal 1-2 cm of seminal vesicle is delineated. A CTV is the union of the gland and the SV. In the Virtual HDR plan, the PTV is the CTV plus an expansion of 2 mm for low risk patients and 5 mm expansion for intermediate risk patients. In the homogeneous plan, the PTV is the CTV plus 3 mm expansion in the posterior and 5 mm elsewhere. In both cases, the following critical organs are contoured: bladder, rectum (15 mm superior/inferior of PTV extent), urethra (within the PTV only), penile bulb, neuro-vascular bundles, testicles and sigmoid colon if located within 15 mm of the PTV. No beams were allowed through the testicles. In the Virtual HDR protocol, the clinical objective is to give 38 Gy in 4 fractions to the PTV with at least 95% coverage of the PTV. The PTV D_{max} is 78 Gy and at least 1% of the PTV should receive 150% of the prescription dose (57 Gy). The prescription dose around PTV should therefore be ≤67%. The conformality index should be less than 1.2 and the plan should require fewer than 200 beams and around 80000 MU. In the homogeneous dose protocol, the PTV receives 36.25 Gy in 5 fractions with at least 95% coverage of the PTV. The prescription dose around PTV should therefore be 75%-85% of D_{max}. The conformality index should be less than 1.25 and the plan should require between 150 to 200 non-zero beams. To evaluate the clinical outcome, 40 patients treated in the Virtual-HDR protocol was followed up. Patterns of prostate specific antigen (PSA) response were analyzed. The early and late urinary and rectal toxicities are assessed. Also the EPIC quality of life was assessed for bladder, bowel, sexual and hormonal domains. **Results:** 1. The DVH for virtual HDR in the PTV show a long tail after the prescription dose demonstrating dose heterogeneity inside the PTV. On the other hand, the DVH drops sharply after the prescription dose for the homogeneous plan. Both the plans nicely spare the OARs, but virtual HDR plan results in lower dose in the most of the critical structures. The DVH in terms of BED demonstrates the BED for late effect in the normal tissues are comparable or lower in most cases in the heterogeneous plan compared to the homogeneous plan. 2. The V_{10Gy}, V_{20Gy}, V_{30Gy} and V_{40Gy} averaged over all patients are consistently lower in bladder and rectum for the virtual HDR plans. The Urethra, which is inside the PTV, the virtual HDR does a better job in sparring. The average bladder V_{20Gy} in the heterogeneous and homogeneous plans are 28.3% ± 7.6% and 38.0% ± 8.2% respectively and for rectum average V_{20Gy} are16.3%±3.4% and 27.1% ± 9.4% in heterogeneous and homogeneous plans. The Urethra V_{40Gy} in the heterogeneous plan is 28.8%±8.6% and 99.7% ± 0.7% in the homogeneous plan indicating better OAR sparing in the heterogeneous plan. 3. A typical virtual HDR plan consists about 190 beams and 80000 MU in four fractions. Typical delivery time for such a plan is about one hour and there are total of 4 fractions. Homogeneous plans consist of 150 beams and about 45000 MU. The estimated average delivery time for such a plan is about 40 minutes and the treatment is delivered in 5 fractions. Therefore homogeneous plan has slightly better edge in terms of the shorter treatment time. 4. Both

the protocols result in encouraging PSA response and favorable toxicity profile. No patient exhibit RTOG Grade III or higher late toxicity. The median PSA drops to 1.1 ng/ml in 12 months and 0.25 ng/ml in 24 months. The EPIC quality of life assessment exhibits minimum decrees in 2 months and subsequent recovery in the bladder domain, no significant change in the bowel domain, decrees to 12 months and followed by recovery in the sexual domain and no significant change in the hormonal domain. **Conclusion:** The unique robotic delivery capability of CyberKnife makes it possible to treat prostates with HDR like dose plans as well as with homogeneous dose plans with excellent OAR sparring. Very encouraging PSA responses up to 2 year follow-up. Toxicity profiles are favorable with typically rapid resolution. The quality of life outcome also is favorable.

Set-up errors in whole abdominal helical tomotherapy based intensity modulated radiotherapy using MVCT in advanced epithelial ovarian cancers

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Aim: To document and determine set-up errors associated with whole abdominal intensity modulated radiotherapy with MVCT Image Guidance. **Materials and Methods:** Eight patients of advanced epithelial ovarian cancers treated with whole abdominal helical tomotherapy based IMRT and MVCT based Image guidance between January 2008 to April 2009 were evaluated. Immobilization used was VACLOC in one patient and 4 clamp Pelvic thermoplastic mould with Knee rest in six patients. Image co-registration was done using MVCT with planning KVCT data set. The objectives were to spare kidneys and bone marrow, so the protocol was to match the kidneys without compromising the pelvic CTV doses. In initial two patients only abdominal scan at the level of kidneys were taken and in subsequent six patients, daily two MVCT scans were taken one to include kidneys and another pelvic scan to include pelvic CTV. Upper abdominal scan was matched for kidneys and pelvic scan was matched for pelvic bones and respective shifts were noted. An average shift was derived using values of both the registrations with a greater weightage to abdominal shifts and final shifts were applied. **Results:** The group systematic error (M) was -1.28 mm, -1.66 mm & 4.62 mm for lateral, longitudinal and vertical shifts respectively and was -0.03, 0.19, -0.09 for pitch, roll and yaw respectively. SD of systematic error (Σ) was 1.86 mm, 7.41 mm & 4.95 mm for lateral, longitudinal and vertical shifts respectively and was 0.09, 0.17 & 0.25 for pitch, roll and yaw respectively. SD of random error (σ) was 3.11 mm, 6.75 mm & 5.48 mm for lateral, longitudinal and vertical shifts respectively and was 0.75, 0.49 & 0.62 for pitch, roll and yaw respectively. **Conclusion:** The translational deviations in Medio-Lateral, Superio-Inferior and Anterio-Posterior axis are higher and should be taken into account while generating PTV margins in non image guided protocols. The rotational errors are minimal and can be ignored.

Patient specific delivery quality assurance of helical tomotherapy using MOSFET and inhomogeneous thoracic IMRT phantom reena

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Introduction: Helical tomotherapy represents a unique approach of delivering Image-guided intensity modulated radiation therapy (IGIMRT). The highly conformal dose distribution and complex dynamic delivery of IMRT in helical mode demand stringent pretreatment patient specific delivery quality assurance (DQA). DQA is done routinely using ion chambers, and a homogeneous cheese phantom. In this retrospective study, we studied the result of DQA done in a inhomogeneous IMRT phantom using MOSFET, ion chambers and EDR2 films. We compared the point dose measured by MOSFET and ion chamber with TPS calculated dose. MOSFETs were kept at various points on the surface of the phantom to evaluate the surface dose and compared with TPS calculated dose. **Materials and Methods:** Patient specific DQA verification plan was created and delivered on an inhomogeneous Thoraxic IMRT phantom (Standard Imaging). It has lung and bone density inhomogeneities and chamber holders at different planes. Film can be inserted at different coronal planes. MOSFETs (TN250RD, Thomson&Neilson, Ottawa, Canada) were calibrated using ion chamber and cheese phantom at Tomotherapy. CT scans of 3mm thickness of the Thoracic phantom along with the ion chambers were taken and configured at the tomotherapy TPS for DQA. We selected 12 patients having primary disease near lung for the study. For every patient, Point dose was measured two times, with ion chamber, (A1SL ion chamber 0.055 cc Volume) and MOSFET inserted at 5 cm depth in the center of the phantom. MOSFETs were also kept at three different locations (center, left, right side) on the surface of the phantom to measure the surface dose. While 2D fluence was measured using EDR2 films and analysis was carried out on Tomotherapy planning workstation using an in-build film analyzing software. Vandyke criteria for gamma index evaluation (3% at 3 mm) were used for quantitative evaluation of 2D fluence map agreement. **Results and Discussions:** The average percent dose variation in ion chamber measurements from TPS was ±1.50%(SD = 1.87 while the percent dose variation in MOSFET measurements from TPS was ±1.18%(SD = 3.34). The average surface dose measured by MOSFET was -11%(SD = 17.36) less from the TPS calculated surface dose. Out of 12 patients,9 patients fulfilled the VanDyk criteria with g £1 while 3 patients failed from it. These two failed patients had high dose gradient region. But it is passing in the criteria of 5% at 3 mm. **Conclusion:** MOSFET Dosimetry system has shown maximum 6% difference between the TPS calculation and the measured dose but ion chamber measurement fulfills the acceptance dose criteria set at 3% even in an inhomogeneous phantom. The surface dose measurement with MOSFET was also in agreement with published data (10-20% overestimation of surface dose by TOMO planning system). In patient specific quality assurance test, we can use MOSFET for multiple point dose and surface dose verification very effectively.

Role of planning organ at risk volume (PRV) revisited in complex 3DCRT of head and neck tumors

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Aim: Ensuring adequate and uniform target coverage while sparing OARs for complex head and neck tumors using 3DCRT techniques can be quite challenging. Treatment planning using 3DCRT is often carried out with beam shaping to spinal cord and not to PRV to ensure adequate target coverage. We carried out a retrospective analysis to estimate the dose to spinal cord (SC) in such patients, taking into account the effect of setup and other uncertainties, comparing it with similar parameters in IMRT. **Materials and Methods:** 24 patients of head and neck cancer were chosen for this study, 12 were treated using IMRT and the others by complex 3DCRT. 7-8 fields were used for 3DCRT, while IMRT was carried out with 9 fields. Treatment planning was carried out on Eclipse (VARIAN) treatment planning system. A dose of 66 Gy/33fr and 66 Gy/30fr were planned for 3DCRT and IMRT, respectively. The recommendations of ICRU 62 were followed for the dose volume objectives. For, SC objective was to achieve a maximum dose of 45 Gy or limit dose to 2% of spinal cord to <48 Gy. For IMRT patients, planning was carried out with PRV drawn over SC of 3mm, while PRV was not considered for 3DCRT planning. A ±3 mm shift at isocenter was applied to both 3DCRT and IMRT plans. Dose volume histograms were recalculated with the shift in the isocenter and the dose to CTV and SC were evaluated. **Results:** The mean dose to SC was 42.6 ± 4 Gy and 50.35 ± 7.14 Gy before and after shifting of the isocenter, respectively for 3DCRT plans, while it was 37.9 ± 2.8 and 42.06 ± 4.3 Gy before and after for the IMRT plans respectively. A difference of 7.75 Gy and 4.2 Gy was obtained for 3DCRT and IMRT respectively. The mean dose to SC was found to be out of tolerance

for 3DCRT, however, for IMRT, it was found to be within tolerance after shifting the isocenter. This could be directly attributed to the optimization of PRV in IMRT, while in 3DCRT, no PRV was used; most of the beam shaping was carried out with no margins to SC. A mean dose difference of 4.2 Gy in IMRT indicates that the high dose gradient generally present in IMRT was effectively reduced by optimizing the PRV. No significant change was observed in CTV with 3 mm shift at the isocenter. **Conclusion:** The results of the present study indicate that PRV plays a major role in sparing the SC, and the exclusion of the same during planning to maintain adequate target coverage may compromise the dose to the same significantly, while accounting for setup uncertainties. To reduce the dose variation between the dose planned and that delivered it is essential to ensure set up accuracy by regular portal imaging while treating such patients.

Respiratory motion management and delivery techniques: Geometric and dosimetric aspects

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Aim: To evaluate the various respiratory motion control & delivery techniques available in radiotherapy and analyze the dosimetric and geometric aspects of these techniques. **Materials and Methods:** Motion control techniques using either respiratory gating during free-breathing or breath holding have been developed. With these techniques, the treatment beam is fixed in space and gated to turn on only when the target, fiducial marker, or other surrogate signal comes into the preplanned area. An arguably better but also more difficult approach is to allow the patient to breathe freely or coached breathing, while a tracking and control system monitors the tumor's position inferred by the position of external/internal markers. By tracking an external/internal signal, which is correlated to tumor motion in real time and the treatment is delivered by either dynamic multi-leaf collimator leaf motion, robotic control of the linac, couch based synchronization or a 4D inverse treatment plan. Presently available techniques using block marker, fiducial, spiro meter, optical/infrared camera, X-ray, DMLC, magnetic transponders and transducer based target tracking & delivery techniques were studied for its dosimetric and geometric properties **Results:** Localization accuracy of these techniques was found to be well within acceptable accuracy. Dose constancy measurements showed insignificant change in output. Tracking using external surrogates found to be consistent under coached/controlled breathing and non invasive. Internal markers found to be more accurate and invasive, which are more suitable for prostate localization. Target localization verification using X-ray assures the faithfulness of the tracking system but adds dose to the imaged volume. Beam delivery using spiro meter and gating techniques eliminates the multi phase planning and takes care organ deformation & rotation, but increases treatment time significantly. Real time tumor tracking & deliveries using adapted DMLC, robotic control of linac and couch based synchronization showed similar accuracy and reduced the treatment time. 4D tomotherapy plan, obtained by incorporating the motion into inverse treatment plan optimization sounds good when controlled breathing with monitoring was performed. **Conclusions:** These techniques provide accurate localization and delivery, when used appropriately, depending on the type of the tumor, its location, proximity to critical organs, patient compatibility and proper planning.

A dosimetric comparison of heart dose in left sided breast cancer radiotherapy with conventional tangential plans as compared to 3D conformal plans

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Aim: To dosimetrically compare heart and left ventricular dose where dose to coronary arteries is of concern in a convertioanal tangential portal as against 3D conformal portal and compare cardiac and left ventricular doses. **Materials and Methods:** 10 patients were chosen with histologically proven breast cancer. All of them had left sided cancer. All of them underwent a planning CT. Both the breasts, heart and both the lungs and the cavity were contoured. Two different plans 1. Conventional tangential plan 2. 3D conformal plan were created for all the patients. The total doses prescribed were 45 Gy -50 Gy followed by boost in patients who required boost by electrons. The dose to 2%, 5%, 10%, 50% volumes and the mean cardiac doses were compared for the Conventional tangential plan and 3D conformal plan. **Results:** There was statistically significant reduction of mean cardiac dose in 3DCRT plans compared to conventional plans (16% Vs 20% with *P* 0.028). Dose to 5% (D5%), 10% (D10%), 20% (D20%) and 50% (D50%) volume of heart were 78%, 71%, 37%, 6% in conventional RT plans as compared to 72%, 51%, 23%, 5% in conformal plans with *P* values 0.028, 0.028, 0.028, 0.043 (Wilcoxon sign rank) respectively. **Conclusion:** Three dimentional conformal radiation has been proved dosimetrically superior compared to conventional radiation in terms of cardiac sparing. As an extension of this study coronary contouring should be done to exactly determine to dose to coronaries and to determine early and late clinical outcomes related to the heart.

Impact of bladder filling on three dimensional dosimetry (3D - DVH) in high-dose-rate intracavitary brachtherapy (HDR - ICBT) with tandem-ring application for cervical cancers: a dosimetric study

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Purpose: To investigate the effect of bladder filling on 3D DVH parameters and determine an optimum bladder volume during HDR-ICBT in Cervical cancers. **Materials and Methods:** In this dosimetric stduy, 14 patients who underwent HDR-ICBT with CT/MR compatible applicator as a routine treatment were invited for this study. Each patient underwent CT planning with bladder emptied (series 1), after 50 ml filling (series 2) and 100 ml filling (series 3). Bladder filling was done with a saline infusion through the bladder catheter. Contouring for bladder, rectum, sigmoid and small bowel in all series and patients was done. Treatment planning was performed on all the three series for each patient on the Eclipse Planning System (Version 8.1; Varian Medical Systems). Treatment planning was done with 7 Gy to point A prescription and manual optimization allowed to reduce dose to the various OAR's without altering the standard loading patterns. Dose Volume Histogram (DVH) for badder, rectum and small bowel were obtained. Recommended 3D - DVH Parameters (0.1 cc, 1 cc and 2 cc doses) and for lower doses and larger volumes 5 cc, 10 cc and mean doses to the OAR's were noted and analyzed. Paired t tests, Pearson correlations and regression analyses were performed. **Results:** The mean (+SD) bladder volume was 62 (+16) ml, 111 (+23) ml and 170 (+24) ml, for series 1, 2 and 3 respectively. Similarly, the mean rectal, sigmoid and small bowel volume for all series were comparable The 1 cc, 2 cc and 5 cc mean bladder doses were significantly higher for 50 ml and 100 ml bladder filling as compared to empty bladder. For eg. the mean 2 cc doses were 6.6 Gy Vs 7.05 Gy (*P* = 0.03) and 6.6 Gy Vs 7.6 Gy (*P* = 0.000) for empty Vs 50ml and empty Vs 100 ml filling respectively. Similarly, for small bowel region, there was trend towards lower doses with 50 ml and significantly lower doses with 100ml filling suggesting a reciprocal relation to bladder doses with bladder filling status. However, the rectal and sigmoid doses were not significantly affected with either series. **Conclusions:** Bladder filling status significantly alters the bladder and small bowel dose volume parameters. The filling status has an inverse relation between the bladder and small bowel doses. There is no significant impact of bladder filling on rectal and sigmoid doses volume parameters. ICBT with empty bladder would be optimal for reducing bladder doses if small bowel doses are clinically acceptable. Clinical data is warranted to evaluate

its impact on bladder late sequelae.

Thoracic

CT scan guided percutaneous interstitial brachytherapy for malignant lung lesions

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Aim: To study the feasibility of CT scan guided percutaneous interstitial brachytherapy (IBT) in malignant lung lesions in patients with primary/ metastatic carcinoma, not suitable for surgery. **Materials and Methods:** Eight patients with primary non small cell lung cancer (NSCLC) or lung metastases, were enrolled in this study. The procedure of IBT was carried out in CT scan room under local anesthesia. A single stainless steel blind end needle for lesions up to 4 cm and two needles for lesions up to 6 cm in diameter were used. The needle was inserted percutaneously through the intercostal space. CT scan based planning was done using slice thickness of 2.5 mm on PLATO planning system. A single dose of 12-20 Gy with high dose rate (HDR) brachytherapy was prescribed at the periphery of lesion. The treatment was delivered on remote afterloading HDR brachytherapy unit in adjacent room and the needle was removed immediately after treatment. An X-ray chest after 2 hours to rule out pneumo/hemothorax and a CT scan after 1 month of the procedure was done to assess status of the treated lesion. **Results:** There were 6 males and 2 females with a median age of 55 years. The lesion size raged from 3.0-5.5 cm (median 4.0 cm). The average time taken in IBT procedure was 50 minutes. No patient had hemo/ pneumothorax or hemoptysis during perioperative period. Only 1 patient had minimal pleural effusion on the next day of procedure. CT scan at one month revealed complete regression (CR) of the lesion in 1 patient; and more than 50% regression (partial regression, PR) in 5 patients and minimal response in 2 patients. At 6 months follow up, 5 patients had complete resolution of the lung lesion. **Conclusion:** CT scan guided IBT is safe and feasible in the treatment of malignant lung lesions. It provides effective tumor control and needs to be studied further.

Evaluation of response and toxicity of treatment in patients with locally advanced non-small cell lung carcinoma receiving concommitant radiotherapy with weekly cisplatin vs three weekly cisplatin

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Aims and Objective: To compare effects on the response and toxicity of treatment in patients with locally advanced non-small cell lung carcinoma receiving concomitant chemoradiotherapy with weekly cisplatin vs three weekly cisplatin. **Materials and Methods:** 40 patients were registered in this study with biopsy proven unresectable NSCLC without distant metastasis were randomized to one of two treatment arms. Arm A - Concurrent chemotherapy was given with weekly Inj.cisplatin 30 mg per sq. meter BSA and Arm B - Concurrent chemotherapy was given with Inj.Cisplatin 70 mg per sq. meter BSA on Day 1 and Day 22 of radiotherapy. All patients were treated by external beam radiotherapy with cobalt-60 with appropriate portals. Patients in both the groups were similar in terms of age (40-65 years), sex (males 80-85%), socio-economic status, history of tobacco smoking (85%) and extent of disease (all were stage III disease). Most common histopathology and site was squamous cell carcinoma (80%) & right upper zone (63%) respectively. 55% patients had history of past tuberculosis. Cough (82.5%) and chest pain (60%) were the most common presenting complaints along with dyspnoea (57.5%), anorexia and weight loss (60%). QOL was evaluated as per the EORTC QOL Questionnaire at the start of treatment, end of treatment and after one month of completion of treatment. **Results:** All the patients were eligible and assessable. The overall response rate was 60% in arm A Vs 70% in arm B. Complete response (20%/15%), partial response (40%/55%), stable disease (25%/15%) progressive disease (15%/15%) respectively in arm A and B at one month follow up. Common grade 3/4 toxicities were dysphagia (20-26%), nausea and vomiting (10-20%), skin reactions (10-15%), pneumonitis (8-12%), anemia, neutropenia and thrombocytopenia (5-10%). QOL assessments did not reveal any significant differences between the two groups. **Conclusion:** Our preliminary result presented in this work does not show any difference between the two arms. Newer treatment approaches with prospective randomized trial need to be evaluated in pursuance to find better avenues for patients of lung cancers.

Ruthenium 106 Plaque Brachytherapy: Indications and Outcome in Ocular Tumors

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Aim: To evaluate Ruthenium 106 (Ru-106) plaque brachytherapy in the management of intraocular and adnexal tumors.

Material and Methods: A retrospective review of the medical records of 84 eyes of 84 patients at the LV Prasad Eye Institute from January 2001 to August 2009 identified a spectrum of ocular tumors managed with Ru-106 plaque brachytherapy. We analyzed the patient demographics, tumor characteristics, radiation parameters, and final outcome. Tumor recurrence and eye salvage were the main outcome measures. **Results:** The tumors included uveal melanoma (28), ocular surface squamous neoplasia (19), choroidal hemangioma (19), retinoblastoma (16) and choroidal metastasis (2). **Uveal melanoma:** The mean patient age was 45.9 (range, 17-76) years. There were 14 male patients. Plaque brachytherapy was the primary treatment in 96% patients. The mean tumor diameter was 12.1 (7-21) mm and mean height was 5.3 (3-8) mm. A notch plaque was used in 71%. The mean tumor apex dose was 9528 (range, 6726- 15194) cGy and mean duration for treatment was 119.6 (45.7 – 261.9) hrs. Tumor regression rate was 67.8%, eye salvage was achieved in 82%, and 71.4% had useful residual vision (>20/200). Complications included scleral necrosis (7.1%), vitreous hemorrhage (7.1%), radiation retinopathy (3.5%), cataract (3.5%), and retinal detachment (3.5%). **Ocular surface squamous neoplasia:** The mean patient age was 49.3 (range, 33– 71) years. There were 10 male patients. Plaque brachytherapy was used to manage residual (excision base involvement on histopathology) or recurrent OSSN. The mean tumor diameter was 8.7 (5-15) mm, and the mean height was 2.3 (1.5-3) mm. A round plaque was used in all. The mean tumor apex dose was 5626 (range, 4896-6736) cGy and mean duration for treatment was 22 hrs. Tumor regression rate was 84.2%, eye salvage was achieved in 78%, and 63.2% had useful residual vision (>20/200). One patient each had scleral necrosis and corneal epithelial defect. **Choroidal hemangioma:** The mean patient age was 28.7 (range, 9– 70) years. There were 8 male patients. Plaque brachytherapy was used as primary treatment in patients with choroidal hemangioma with diffuse subretinal fluid. The mean tumor diameter was 12.7(8-18) mm, and the mean height was 5 (3.6-9) mm. A notch plaque was used in 89%. The mean tumor apex dose was 3246 (range, 2496 - 6018) cGy and mean duration for treatment was 48.7(16 - 97.4) hrs. Tumor regression rate was 89.6%, eye salvage was achieved in all and 57.9% had improvement in visual acuity (>2 Snellen lines). **Retinoblastoma:** The mean patient age was 3.5 (range, 1.4– 6.7) years. There were 10 male patients. Plaque brachytherapy was used to treat residual or recurrent retinoblastoma. The mean tumor diameter was 9.8 (5 – 18) mm and mean height was 4.6 (2.5 – 6) mm. A notch plaque was used in 50%. The mean tumor apex dose was 4699 (range, 1955 - 7568) cGy and mean duration for treatment was 72 (16.8 – 124.8) hrs. Tumor regression rate was 68.8%, eye salvage was achieved in 60%, and 33.3% had useful residual vision (>20/200). Complications included radiation retinopathy in 6.6% and vitreous hemorrhage in 6.6%. **Choroidal Metastasis:** The patient age was 52 and 72 years, both

were male patients. Plaque brachytherapy was used to treat solitary choroidal metastasis. The tumor diameter was 4 mm and 13.6 mm and mean height was 5.2 (3.6 – 6.8) mm. A notch plaque was used in 100%. The mean tumor apex dose was 4995 (range, 4992 - 4998) cGy and mean duration for treatment was 48.5 (48.2 – 48.9) hrs. Tumor regression was seen in both, eye salvage was achieved in 100%, and 100% had useful residual vision (>20/200). No complications were encountered. **Conclusion:** Ruthenium 106 plaque brachytherapy is a reasonable treatment option for the primary management of choroidal melanoma and choroidal hemangioma with diffuse subretinal fluid, and for the management of residual or recurrent ocular surface squamous neoplasia and retinoblastoma. It provides for good tumor regression and eye salvage. Complications seem dose-dependant.

Computer generated image guidance in Prostate Brachytherapy provides consistent post-implant dosimetry

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Aim: To demonstrate that an image guided intra-operative planning system using ultrasound guided needle placement with sagittal views results in consistent post-operative dosimetry. **Material and Methods:** In our institute 320 patients have had prostate brachytherapy performed using an intra-operative planning and delivery system (FIRST®). Of these, 172 patients have more than 24 months of follow up (range 24-56 months). The prescribed reference dose was 144Gy to the prostate plus 3-5 mm margin. Average seed activity was 0.434 mCi. Planning parameters were V100 > 99%, V150 (75 to 80%), V200 (35 to 40%) and intra-op D90 >190Gy. **Results:** The mean D90 planned intra-operatively was 194.4Gy (171.3-213.8Gy). Pre image guidance and inverse planning post implant D90 ranged from 133–199Gy (mean 162.7Gy), V100 85.8-99.4% (mean 93.9%). After image guidance the range of post op D90 decreased to 152–182.7Gy (mean 158.5Gy) and V100 90.1-98.3% (mean 93.8%). **Conclusion:** Computer guided intra-operative prostate brachytherapy with needle guidance and inverse planning allows for consistent intra-operative planning parameters that results in improved post-op dosimetry by reducing the range of post-op D90 to 30.7Gy vs. 66Gy and V100 to 8.2% vs. 13.6%.