Radiation Protection

Oral Presentations

0015

Estimation of pneumonitis and long term cardiac mortality for gated radiotherapy with a bootstrap statistical method

Abdulhamid CHAIKH[1,2], Jean-Pierre BRESCIANI[3], Jacques BALOSSO[1,2]
[1]Department of Radiation Oncology and Medical physics, Grenoble University Hospital, France, Grenoble, France, [2]University Grenoble-Alpes, Grenoble, France, [3]University of Fribourg Department of Medicine, Swizerland, Switzerland

Purpose: To apply a statistical bootstrap analysis to assess the dose response relationship for pneumonitis and myocardic toxicity as endpoints, using radiotherapy with respiratory gating for left breast cancer treatments.

Material and methods: ten cases with left sided breast cancers were studied. For each case, 2 treatment plans were generated. Plan 1 was generated using free breathing and Plan 2 using the respiratory gating method. Normal Tissue Complication Probabilities (NTCP) for lung and heart were carried out using Lyman Kutcher-Burman model and Equivalent Uniforme Dose model. Wilcoxon and Spearman's rank tests were used to calculate p-value and the correlation coefficient (r). The bootstrap method was used to evaluate the confidence interval with N= 1000 random iterations.

Results: using the gated radiotherapy for left breast cancer the maximum doses to heart and lung were significantly decreased. Therefore, NTCP for pneumonitis and long term cardiac mortality were significantly reduced. A good correlation was observed due to increased distance between target and surrounding healthy tissues and increasing lung density.

Conclusions: We assessed the protection of lung and heart in whole breast radiotherapy using the parameters of the radiobiological models. Delivering the prescribed dose with respiratory gating will significantly decreasing NTCP for lung. The bootstrap method provides a statistical estimation of NTCP and its 95% confidence intervals, which limits are the estimations of the upper and lower risk of toxicity, based on a limited numbers of patients as "n=10".

0018

Accurate IMRT fluence verification for prostate cancer patients using 'in-vivo' measured EPID images and in-room acquired kilovoltage cone-beam CT scans

Ali Sid Ahmed Mohammed Ali[1,2], Maarten Dirkx[1], Ruud Cools[1], Ben Heijmen[1]
[1]Erasmus MC Cancer Institute, Rotterdam, The Netherlands, [2]Al Neelain University, Khartoum, Sudan

Purpose:To investigate the comparison of 'in-vivo' measured portal dose images with predictions based on a kilovoltage cone-beam CT scan.

Methods:PDI prediction accuracy was first validated for an anatomical phantom, using IMRT treatment plans of ten patients. Clinical performance was studied using data acquired for 50 prostate cancer patients. For each patient, 4–5 CBCTs were available. Measured and predicted PDIs were compared

using γ-analyses with 3% dose difference and 3 mm distance to agreement . To quantify improvements in IMRT fluence verification accuracy, results from multiple fractions were combined by generating a γ-image with values halfway the minimum and median γ values, pixel by pixel.

Results:For patients, CBCT-based PDI predictions showed a high agreement with measurements, with an average percentage of rejected pixels of 1.41% only. In spite of possible intra-fraction motion and anatomy changes, this was only slightly larger than for phantom measurements (0.86%). For pCT-based predictions, the agreement deteriorated (average percentage of rejected pixels 2.98%), due to an enhanced impact of anatomy variations. For predictions based on CBCT, combination of the first 2 fractions yielded gamma results in close agreement with pre-treatment analyses (average percentage of rejected pixels 0.63% versus 0.35%, percentage of rejected beams 0.6% versus 0%). For the pCT-based approach, only combination of the first 5 fractions resulted in acceptable agreement with pre-treatment results.

Conclusion: CBCT scans can be used for high accuracy IMRT fluence verification based on in-vivo measured EPID images. Combination of γ results for the first 2 fractions can largely compensate for small accuracy reductions.

0021

Late Genitourinary (GU) Grade III or higher (>G3) Toxicity following stereotactic body radiotherapy (SBRT) for clinically localized early stage prostate cancer

soha Ahmed, Mack Roach
University of California ,Sanfrancisco (UCSF), Sanfrancisco, USA

Introduction:SBRT is a promising treatment for localized Prostatic Cancer involves delivering short course of precise high dose external beam radiotherapy.It is less expensive,more convenient based on multiple studies series,its use is associated with high rate cancer control comparable to conventional intensity modulated radiation without evidence of increased GI (gastrointestinal) toxicity.This study summaries the incidence of late GU morbidity factors that correlated with this risk

Materials and Methods: Systemic review including 16 published articles between 2007-2014 via PubMed, major radiation oncology journals and reference lists from primary articles including the late GU side effects following SBRT for adenocarcinoma of the prostate. The paper selected for inclusion were required to meet the inclusion criteria Potential predictors for late GU toxicity are:whether the urethra was identified by MRI or catherter,dose constrains used for the bladder,urethra and or penile bulb,history of TURB;base line AUA score

Results: Sixteen papers including 1884 patients analysed.The average incidence of Late GU toxicity relatively low 1.7%.Average incidence of the G3 GU toxicity for the patients follow up<38 months and >38 months is 2%and1.8% respectively.Among the studies with < 2% toxicity (mean= 0.65%) 65% used urethral identification either by catheterization or by MRI.Studies reporting>2% toxicity (mean=3.9%) 70% did not identify the urethra in the planning process

Conclusions:SBRT for clinically localized prostate cancer appears to be relatively safe and effective treatment for early prostate cancer with high survival control rate and accepted toxicity profile,the G3 late GU toxicity may be improved with better urethral identification

0052

Optimization of cranio-spinal irradiation for paediatric medulloblastoma using VMAT and IMRT

Rolina Al-Wassia[1], Camelia Constantinescu[2], Yasir Bahadur[1], Nisreen Awad[1,3], Noor Ghassal[2], Adly Naga[2,3]
[1]King Abdulaziz University Hospital, Jeddah, Saudi Arabia,[2]King Faisal Specialist Hospital & Research Center, Jeddah, Saudi Arabia,[3]National Cancer Institute, Cairo University, Cairo, Egypt

Purpose:
To retrospectively compare VMAT and IMRT for cranio-spinal-irradiation (CSI) of standard-risk medulloblastoma (MB) paediatric patients and to estimate their impact on the potential clinical benefit.

Methods and materials:
We selected 10 paediatric MB patients, with a median age of 7.5 years, who received CSI with a dose of 23.4 Gy, followed by a boost to posterior fossa up to 55.8 Gy.
Clinical and planning-target-volumes were contoured on axial CT-images. Dose distributions to target and OARs for each planning technique (VMAT and IMRT) were measured and compared with published dose-volume toxicity data for paediatric patients.

Results:

Analysis and comparison of dose distributions and DVHs demonstrated the following:
1. VMAT had a modest, but significantly better, planningtarget volume-dose coverage and homogeneity compared with IMRT; (2) there were different OAR dose-sparing profiles for IMRT versus VMAT; (3) neither IMRT nor VMAT demonstrated dose reductions to the published pediatric dose limits for the eyes, the lens, the cochlea, the pituitary, and the brain; and (4) the low dose spread to non-target tissue was lower and statistically significant ($p=0.00625$) for VMAT plans (V5Gy of 37.37% for VMAT vs. 40.69% for IMRT), and showed an inverse linear dependence with the patient antero-posterior diameter at xyphoid level.

Conclusion:

VMAT and IMRT produce similar dose distribution for CSI of paediatric patients. Paediatric patients with standard-risk MB remain at risk for late endocrinologic, sensory (auditory and visual), and brain functional impairments. Further research is needed to assess the clinical benefit of novel radiotherapy modalities.

0061

Assessment of uterine perforation and its dosimetric effects in image-guided HDR brachytherapy for cervical cancer

Yasir Bahadur[1], Ashraf Hassouna[2,3], Maha Eltaher[1,3], Mohammad Attar[1], Camelia Constantinescu[2]
[1]King Abdulaziz University Hospital, Jeddah, Saudi Arabia,[2]King Faisal Specialist Hospital & Research Center, Jeddah, Saudi Arabia,[3]National Cancer Institute, Cairo University, Cairo, Egypt

Purpose:

To retrospectively assess the incidence of sub-serosal and uterine perforation of intra-uterine tandem in intracavitary high-dose-rate (HDR) brachytherapy for cervical cancer, and to evaluate its dosimetric implications on CT-based treatment planning.

Material and methods:

CT-images and brachytherapy plans of cervical cancer patients treated from February 2006 to December 2012 were reviewed for sub-optimal implants (sub-serosal and uterine perforation), and their correlation with FIGO-stage and patients' age. For each patient, the plans showing sub-optimal insertion of intra-uterine tandem were compared to plans with adequate insertion. The difference in dose coverage of clinical-target-volume (CTV) and variation of the dose delivered to organs-at-risk (OARs) rectum and bladder were evaluated.

Results:

A total of 231 brachytherapy plans for 82 patients were reviewed. We identified 12(14.6%) patients and 14(6%) applications with uterine perforation, and 12(14.6%) patients and 20(8.6%) applications with sub-serosal insertion of tandem. Data analysis showed that advanced stage correlates with higher incidence of sub-optimal implants (p = 0.005) but not the age (p = 0.18). DVHs analysis showed large variations for CTV dose coverage: D90 significantly decreased with average of -115.7%±134.9% for uterine perforation and -65.2%±82.8% for sub-serosal insertion (p=0.025). The rectum and bladder dose assessed by D2cc increased up to 70.3% and 43.8%, when sub-optimal insertion occurred.

Conclusions:

We report a low incidence of uterine perforation and sub-serosal insertion of uterine tandem in intracavitary HDR brachytherapy for cervical cancer. However, the effects on treatment plan dosimetry can be considerably detrimental. Therefore, we recommend image-guided insertion, at least for the challenging cases.

0088

Stereotactic Radiotherapy for Localized Prostate cancer, which is better Cyberknife or Rapid Arc?

MOHAMED HEGAZY[1,2], RANA MAHMOOD[1], BELAL MOFTAH[3], AHMED NOBAH[3], FAISAL ALZORKANI[3]
[1]Department of Radiation Oncology, KING Faisal Specialist Hospital & Research Centre,, Riyadh, Saudi Arabia,[2]2Department of Clinical Oncology &Nuclear Medicine, Zagazig Faculty of Medicine, Zagazig, Egypt,[3]Department of Biomedical Physics, King Faisal Specialist Hospital and Research Centre,, Riyadh, Saudi Arabia

Aim: The aim of this study was to evaluate the feasibility and dose distribution of two different stereotactic body radiation therapy (SBRT) techniques, isocentric Rapid Arc (RA) and non-isocentric CyberKnife (CK), for the treatment of localized prostate cancer.

Methods: The study included six patients treated with CK then replanned with RA. The prescription dose was 36.25 Gy in five fractions. The two SBRT techniques were compared by target coverage, normal tissue sparing, and dose distribution parameters. Monitor units (MUs) and the delivery time were compared to assess delivery efficiency.

Results: The RA plans exhibited superior PTV coverage (PTV mean 100% vs 105% and PTV maximum 107 vs 127%) and better bladder (V36 Gy 1.8% vs 4.1%) and rectum (V36 Gy 0.25% vs 0.71%) sparing at high doses. The conformity and homogeneity indices of the RA plans were better than the CK plans (CI mean 1.05 vs 1.2 and HI mean 1.1 vs 1.27). Additionally, the RA plans resulted in lower dose regions, lower monitor units, and faster delivery times (mean 2 minutes) than the CK plans (mean 34 minutes).

Conclusions: The good dosimetric distribution and shorter delivery time make RA an attractive SBRT technique for the treatment of localized prostate cancer.

0105

Out-of-Field Radiation Organ Dose Measurements and Associated Secondary Cancer Risk Estimation in Patients Treated with Breast Cancer in Lebanon

Ibrahim Duhaini[1]
[1]Rafik Hariri University Hospital, Beirut, Lebanon, [2]American University of Beirut, Beirut, Lebanon, [3]Beirut Arab University, Beirut, Lebanon

Introduction: According to the National Cancer Registry in Lebanon for the years 2003 till 2007, more than 40 % of registered cancers in Females have Breast Cancer. According to the latest Report published by the NCR, Breast cancer remained the most relatively frequent cancer throughout the years (42-43%). The annual incidence rate for breast cancer has been increasing from 72/100,000 in 2005, to 87/100,000 in 2007. According to the World Health Organization 2003 Report, Breast cancer is the leading cause of cancer deaths worldwide in women under the age of 55 and more than one million women are diagnosed with breast cancer each year.

In radiation therapy, our concern, the tumor in the Breast will be exposed to high-energy X-rays that destroy cancerous cells. It is often used as post-surgery therapy in an effort to kill any remaining undetectable cancer cells that may have invaded areas nearby the original site of the tumor.

Purpose: During radiation therapy of the breast, other organs in the body may receive a significant radiation dose that triggers a secondary cancer in these organs. In this study, the Out-of Field radiation doses will be measured in some organs and will be evaluated for the development of radiation induced cancer as recently defined by the International Commission on Radiological protection (ICRP).

Materials and Methods: An anthropomorphic phantom will be used with Thermo- Luminescence Dosimeters (TLD) to physically measure organ doses when the breast is irradiated with a complete clinical dose prescription for cancer treatment.

0111

KFSH&RC experience: Statistics of patients treated by intraoperative radiation therapy (IORT) using Mobetron®

Shada Wadi-Ramahi, Abdullah Alsuhaibani, Belal Moftah
King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

We present statistical analysis of our patients treated with Intra-operative (IORT) using the Mobetron®, which is an X-band mobile linac capable of producing electron energies of 6, 9 and 12MeV and operating at a nominal 1000MU/min. The machine came equipped with various electron cones with diameters from 30-100mm in steps of 5mm, each with three bevel angles; zero, 15 and 30degrees.
One hundred and three (103) patients were treated from August/2013 until end of Dec/2015 with a total of 118 irradiation fields; 11 patients had two irradiation fields, 1 patient had three fields and 1 patient got re-irradiation after one year. Male/female ratio is 61/42 with median age of 46.5years (19-77). Treatment depth is decided by surgeon and radiation oncologist, whereas electron energy is decided by radiation oncologist with medical physicist. Prescribed isodose lines range from 70%-100% depending on various factors including beam obliquity, cone size, patient anatomy and required penetration depth.
The types of tumors treated are: Gastric, pancreatic, sarcomas, seminomas, ovarian, colorectal, rectal, and colon among others. The frequency of usage of electron energy is: 6MeV(12%), 9MeV(53%) and 12MeV(35%) and the two mostly used cones are the 100 and 80mm (24% each). The 30deg angle has the highest usage (45%) whereas the zero and 15deg have equal usage (27%). The maximum dose, relative to prescription, inside the patient ranged from 100% to 130%.
We have successfully treated variety of tumors in 103 patients with IORT and currently we are performing clinical study to analyze of the treatment outcome.

0118

Comparison Homogenity Index (HI) and Conformity Index of Radiotherapy Planning in 3D-CRT and IMRT for Lung Cancer with Fan Beam CT and Cone Beam CT

Muhammad Waliyyulhaq[1], wahyu Edy Wibowo[1,2], Supriyanto Ardjo Pawiro[2]
[1]*Departemen of Radiotherapy, National General Hospital,, DKI JAKARTA, Indonesia,*
[2]*Departement of Physics, Faculty of Mathematics and Natural Sciences, University of Indonesia, DEPOK, WEST JAVA, Indonesia*

The one of the treatment plans to lung cancer therapy is using IMRT techniques. Recently, the role of Cone Beam CT (CBCT) can be used not only to position the patient at the time prior to irradiation. The CBCT is also used to do the planning, though still in the research stage. This research aims to compare the quality of planning by using conformity index (CI) and homogeneity index (HI) for lung cancer cases using Fan Beam CT (FBCT) and Cone Beam CT (CBCT). We evaluated the impact of dose grid, electrons density calibration based on fan beam and cone beam CT. The results of shows the patient with big size target volume have tendency low CI value and high HI. On the use of grid dose variation, the CI and HI values less than 0.02 and 0.013, respectively. The differences between the cone beam and fan beam calculation were 10% for CI and 60% for HI. finally based on the result, The treatment plan using CBCT can't be used.

0138

The use of Intraoperative electron-beam radiation therapy (IOERT) in multimodality approach. A single institution experience.

Abdullah Alsuhaibani[1], Ahmed Elashwah[1], Mohammad Breakeit[1], Rana Mahmood[1], Noha JASTANIYAH[1], Shada ALramahi[1,2], Luai Ashari[1], Ayman Azzam[1], Ali ALZAHRANI[1], Muhammad Hussain[1], Hind Alselham[1], Sameha Pickford[1], Zeinab Hassan[1], BELAL MOFTAH[1], Mohammed Mohiuddin[1], Tarek Amin[1]

[1]*King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia,*[2]*Department of General Surgery, Alexandria University, Alexandria, Egypt*

PURPOSE:

To assess the feasibility of intraoperative radiotherapy (IOERT) and short-term toxicities of patients treated in a multidisciplinary protocol including IOERT.

METHODS:

We retrospectively evaluated all patients who received IOERT as part oft their multidisciplinary treatment at our institution KFSH&RC From August 2013 until Dec 2015 were analysed

RESULTS:

A total of 103 patients were analyzed with total of 118 IOERT applications.13 pts had more than one application. 61 pts. were males and 42 were females. Mean age was 47 years (19-77). The median follow-up time was 6 months .The prescribed dose range from 5-20 Gy using 6 , 9 and 12 MeV electron energy .41 pts had Upper GI cancers, 16 pts. had colorectal cancers ,21 pts had retroperitoneal sarcoma ,13 had Gynaecological malignancies ,7 pts, had Genitourinary cancers and 5 pts had other cancers . R0 resection achieved in 72 pts while 29 pts had R1 resection and 2 pts had R2 resections.

Most of the patients underwent major surgeries and 38 pts had hyperthermic intraperitoneal chemotherapy (HIPEC) in addition to IOERT.

The reported short-term toxicities were as follow: 2 pts developed post op bleeding, one patient had Pulmonary Embolism, 9 pts developed leakage and 12 pts developed abscess. No reported perforations, fistula or nerve injuries.

CONCLUSION:

Incorporating Intraoperative electron-beam radiation therapy (IOERT) in a combined multimodality treatment in selected patients was well tolerated by the patients and associated with acceptable short-term morbidity. A longer follow-up is needed for evaluation of any potential late side effects.

0139

Dose escalation with Simultaneous Integrated Boost (SIB) using Image Guided Intensity Modulated Radiotherapy in Rectum Cancer.

Abdullah Alsuhaibani, <u>Ahmed Elashwah</u>, Nasser Alsanea, Rana Mahmood, Mohammed Mohiuddin
King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia

INTRODUCTION

Dose escalation with Simultaneous Integrated Boost (SIB) using Image Guided Intensity Modulated Radiotherapy (IMRT/IGRT) approach was implemented at KFSHRC in Feb 2013.Here we update our previously reported experience.

MATERIALS AND METHODS

All patients who had Neoadjuvant Chemoradiotherapy (NACRT) between Feb 2013 and August 2015 were selected from database. A total of 45 patients were identified, 15 were females and 30 were males. Average age was 57 years (28-78). Staging workup including EUS and MRI scan confirmed T3/T4 disease in 43 patients (96%) while two had T2 lesion. Average tumour size was 5.7 cm (2-11). Average time between end of radiation treatment and surgery was 8.5 weeks (6-12).39 (87%) patients had N+ disease . Circumferential Resection Margin (CRM) was involved in 25 (56%) patients. Average distance from anal verge was 5.7 cm (1-10). total dose of 50-55Gy was prescribed in 25 fractions with SIB.

RESULTS

There was no Grade 3/4 toxicity and all treatments completed without break. After NACRT, 13 patients underwent abdominoperineal resection and 32 had anterior resection all with negative margins. There were no immediate post-operative complications. 11 pts.(24.4%) had complete pathological response (pCR) while 8 had near complete response. 35 (78%) patients had negative nodes .

CONCLUSION

Dose escalation with SIB using IMRT/IGRT as NACRT for rectal cancer is feasible. Moreover it is likely to increase the rate of pCR from historic rate of 7% at KFSHRC. Nevertheless clinical benefit of this approach needs to be validated in a larger cohort of patients with longer follow up.

0144

Comparison of TomoTherapy and RapidArc in Hippocampus Sparing Brain Radiotherapy in Pediatrics.

Mohamed Nazmy[2], Ghadeer Nazer[1], Amr Mousa[1,2], Belal Moftah[1], Yasser Khafaga[1,2]
[1]*King Faisal Specialist Hospital and Research center, Riyadh, Saudi Arabia,*[2]*Cairo University, National Cancer Institute, Cairo, Egypt*

Background and Objectives: Both TomoTherapy and RapidArc have been examined in hippocampus sparing whole brain irradiation in adults. We aim to compare both techniques in pediatrics with relatively smaller brain volume. **Patients and Methods**: The hippocampus, the whole brain and the eyes were manually contoured in 3 pediatric patients. TomoTherapy plan was created aiming at adequate brain coverage and as low as possible hippocampus dose, RapidArc was challenged to achieve similar or better plan results. The prescription dose was 36 Gy in 20 treatment fractions to the whole brain. **Results:** TomoTherapy was able to achieve a mean hippocampus dose of 13.6 Gy with brain homogeneity index [HI] of 0.14. Using RapidArc [single arc], the same hippocampus dose was not achievable without compromising the brain HI significantly. By using 2 arcs, similar results to the TomoTherapy plan were achieved. The treatment time for TomoTherapy was 3.5 minutes while it was 1.2 minutes for single arc and 2.4 minutes for two arcs. **Conclusions**: TomoTherapy can achieve better target coverage with lower doses to the hippocampus compared to single arc RapidArc technique, while using 2 arcs RapidArc can achieve similar results with shorter treatment time.

Keywords: TomoTherapy, RapidArc, Hippocampus, Pediatrics

0158

Comparison of Beam Parameters of 6MV Flattening-Filter-Free Beams from Varian Clinac Series and Truebeam System

Abrar Hussain, Belal Moftah

King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia

Purpose: New generation of linacs, TrueBeam (TB) system with completely updated head components and software has several features different than Clinac series, include flattening-filter-free (FFF) photon beams. FFF feature is also introduced in Clinac series, not very common. The comparison of FFF beam parameters on both machine types with different head design was presented in this work.

Methods: The FFF beam PDDs, profiles, output factors, dosimetric leaf gap and MLC transmission data was collected on Clinac series. Some of the components of 6X-FFF data from TB representative data, a clinical TB machine data and a Clinac series data were inter-compared.

Results: The water tank scanning data was depicted for qualitative representation and quantitative analysis. Measured beam parameters, penumbra, flatness/symmetry, %dd(10)x from profiles, PDDs and output factors in tabulated numbers-form from both systems will be presented if selected. The dosimetric leaf gap (DLG) for Clinac series 6X-FFF beam is 1.09mm-1.12mm and MLC transmission 1.3%-1.4% during two separate measurements. DLG for TB system published in literature is 1.16mm. DLG for 6X measured was 1.32mm-1.33mm with MLC transmission 1.5%-1.6% from same 2300IX Clinac machine.

Conclusions:

The comparison of 6X flat beam from both Clinac series & TB system and, 6x-FFF beam from TB system has been published in literature. Current work provides comparison of 6X-FFF from Clinac series and TB system for better understanding of FFF mode. Dosimetric data from Clinac series and TB system were almost identical.

Posters

0016

Simultaneous integrated boost By RapidArc therapy plus temozolomide for treatment of patients with Glioblastoma Multiform: A single institution experience

Mohamed Daoud

Mansoura University, Mansoura, Dakahlia, Egypt

Background: The aim of this study is to report the treatment outcomes, toxicities, and dosimetric feasibility of simultaneous integrated boost by Rapid Arc (RA-SIB) compared with 3D-CRT for patients with glioblastoma.

Patients and Methods: Eleven patients with unifocal glioblastoma (grade IV astrocytoma, WHO classification) were treated during the period from April 2011 till February 2013 with postoperative irradiation and concomitant temozolomide 75mg/m2 followed by 6-12 months of adjuvant temozolomide 200mg/m^2 for 5 days/4weeks. SIB-RA technique was used and patients received 46 Gy per fraction of 2 Gy in 23 sessions on the PTV1 with concomitant daily superimposed boost (SIB) on PTV2 corresponding to the contrast enhancement + 2.3 cm. The DVH analysis was performed between SIB-RA and 3D-CRT plans of each patient. For the PTV, the comparison parameters included, the mean dose, the standard deviation, maximum dose, conformity index (CI), and homogeneity index (HI).

Results: The median progression free survival (PFS) and overall survival (OS) were 13 months (95% CI, 8.2-17.8), and 16 months (95% CI, 2.1-29.9) respectively. Four of six patients (67%) showed local progression (recurrence) after initial response, all recurrences occurred at the site of PTV2. Seven

patients experienced acute grade 1-2 toxicities during the treatment. Late post radiation brain edema was reported in 3 patients.

Conclusion: The SIB-RA did not prove the superiority in survival outcomes compared with the historical data using 3D-CRT. From the dosimetric standpoint, SIB-RA is a superior technique with respect to 3D-CRT when there are overlaps between OARs and PTV.

0025

Calculation of Organs Radiation Dose in Rectal carcinoma External Irradiation Beam

Yousif Abdallah[1], Abdelazeem Khalifa[2], Mohamed Gar-elnabi[3]
[1]Radiological Science and Medical Imaging, College of Applied Medical Science , Majmaah University, Majmaah, Riyadh, Saudi Arabia, [2]Radiation Oncology Department, National Cancer Institute, University of Gezira, Wad Madeni, Sudan, [3]Radiotherapy and Nuclear Medicine Department, Sudan University of Science and Technology, Khartoum, Sudan

The study was established to measure the amount of radiation outside the treatment field in external beam radiation therapy using day method of dose calculation, the data was collected from 150 patients of rectal carcinoma in order to determine if the dose outside side the irradiation treatment field for spleen, liver, both kidneys, small bowel, large colon, skin within the acceptable limit or not. The rectal field included mainly 4 organs which are bladder, cervix and hip joint these organ received mean dose of (4781.987±281.321), (4736.91±331.8), (4647.64±387.1) and (4745.91±321.11) respectively. The mean dose received by outfield organs was (77.69±15.24cGy) to large colon, (93.079±12.31cGy) to right kidney (80.688±12.644cGy) to skin, (155.86±17.69cGy) to small bowel. This was more significant value noted.

0026

Outfiled Dose Calculation in Treatment of Breast Cancer Using Radiotherapy TPs

abdoelrahman bakry, mohamed garelnabi, yousif abdullah, omer hamid
sudan university of science and technology, khartoum, Sudan

This was analytical study carried out to calculate the amount of radiation dose received by critical organ inside and outside radiation field in external beam radiation therapy of breast cancer to evaluate unnecessary radiation hazard that may arise from it, and to extract the better precaution that should be done in order to manage the unacceptable doses. Conventional radiotherapy is the most method used to treat cancer in developing countries. This study was conducted in radiation and isotopes center of Khartoum (RICK) in December 2014, 85 patient was undergoing dose computation using pinnacle 3 treatment planning system which used to distribute and calculate the dose to point inside and outside radiation field limit for the lung and skin using central axis dose calculation parameters, the variable collected was isodose line at measurement points, %DD, separation SQR, age and the stage of disease. The mean dose was 3168.2±453.3cGy, 539.4±147.8cGy, 2914.167±629.13cGy for lung and skin respectively. This dose is considered significantly high and may exceeding the tolerance of this organ which lead to increase radiation complication to the patient.

0027

Detection and GTV Definition of Brain Tumors in MRI Images Using Image Processing Technique

abdoelrahman hassan, mohamed garelnabi
sudan university of science and technology, khartoum, Sudan

This was experimental study conducted to detect and determination of the GTV for radiotherapy planning in brain tumor in MRI images using edge detection and image processing techniques. For brain MRI images was done using GE MR Scanner (1.5 tessla) then treated as dicom format preparing for image processing program (IDL), where the region of interest segmentation was studied. The scanned image was saved in a TIFF file format to preserve the quality of the image in order to segment the background from the foreground brain tissue. Brain tissue can be easily detected in MRI image because it has better image contrast and resolution. T1 weighted images with gadolinium contrast enhancement where used in this study. We use the histogram equalization function for more uniform pixel distribution and differentiation, edge detection and basic morphology tools to detect a tumor margin using laplacian filter, Roberts and sobel function of edge detection and label region segmentation after thresholding process of tumors intensities. The results of this study were that it showed an alternate method for displaying, detection and tumor delineation accurately, where the outline was drown around the irregular tumor margin accurately and the GTV was identified for radiotherapy further planning. Those processing approaches can help in achieving of radiotherapy goals and for better diagnosis also by increase diagnostic information of Brain tumors in MRI.

0051

IMRT treatment plan dosimetry as a predictor for loco-regional control in head-and-neck cancer

Camelia Constantinescu[1], Yasir Bahadur[2], Rolina Al-Wassia[2], Nisreen Awad[2,3]
[1]King Faisal Specialist Hospital & Research Center, Jeddah, Saudi Arabia, [2]King Abdulaziz University Hospital, Jeddah, Saudi Arabia, [3]National Cancer Institute, Cairo University, Cairo, Egypt

Purpose/Objective:
To retrospectively assess the loco-regional disease control in head-and-neck-cancer (HNC) patients treated with IMRT and estimate the role of treatment plan dosimetry as a predictor for loco-regional-control (LC).

Material/Methods:
Between February 2012 and February 2014, 30 consecutive patients with HNC were treated with SIB IMRT. Their demographic and clinical variables (age, T and N stage and chemotherapy) were analyzed. Planning CT images of patients with loco-regional-failures were reviewed, seeking for a possible correlation between LC and the dose delivered to the area where relapse occurred. DVHs were used to extract D95%, D98%, Dmean and Equivalent-Uniform-Dose (EUD) values. Correlation of the available variables with LC was assessed by a logistic regression test.

Results:
After a median follow-up of 12 months (range: 1-28 months), 8 (26%) patients presented loco-regional-relapse and 22 (64%) were free-of-disease. During this time, 3 (10%) patients died; all of them were tongue cancer cases. Significantly improved LC was associated with nasopharyngeal diagnosis (p=0.0004), early stages (T1, p=0.0454; N0, p=0.0024), and the use of concomitant chemotherapy (p=0.0028). Treatment plans evaluation showed that all loco-regional relapses occurred within the 95% isodose line inside the PTV of the primary disease. Dosimetric analysis showed a weak correlation between LC and D95% and D98%, but a strong dependence on Dmean (p=0.0274) and EUD (p=0.0483).

Conclusion:

LC for HNC patients treated with SIB IMRT significantly correlates with pathology, stage and the use of concomitant chemotherapy. Dosimetric data such as Dmean and EUD appear to be useful predictors of LC for this group of patients.

0064

Dosimetric effect of segments number in IMRT

Ismail Ahmed[1,2], Mahmoud Younes[2], Eyad Alsaeed[2]
[1]Faculty of Medicine, Ain Shams University, Cairo, Egypt, [2]King Saud University Medical City, Riyadh, Saudi Arabia

Purpose: To investigate the planning complexity and dosimetric impacts of direct aperture optimization (DAO) in IMRT treatment of brain and breast cancers.

Materials and methods: three breast and five H/N patients were planned using the beamlet optimizer in Elekta-Xio[©] ver 4.6 IMRT treatment planning system. Based on our experience in beamlet IMRT optimization, PTVs in brain were prescribed to 66-Gy using 5-fields, while breast PTV were prescribed to 50-Gy with 2-tangential fields. All cases were re-calculated using Direct Aperture optimizer (DAO) in Prowess Panther[©] ver 5.01 IMRT planning system at same configurations and dose constraints. Plans were evaluated according to ICRU criteria, number of segments, number of monitor units and planning time.

Results: In brain case, beamlet optimization was better than DAO for both GTVs and PTVs in 95% isodose coverage, and the hot area was about 7% more in beamlet plan than DAO plan. For OAR, results showed an improvement in OAR sparing up to more than 35% when using DAO except optic chiasma sparing which was about 20% in beamlet optimizer plan.

For Breast plans, beamlet plans D_{95}<0.8% than DAO plans. OAR results showed an improvement in lung sparing in beamlet plans. While heart sparing improved in DAO plans than beamlet plans. These results achieved using 45% less segments and 50% less MU as well.

Conclusion: DAO introduces considerable advantages over beamlet optimization in regards to organ at risk sparing. While no significant improvement occurred in the ICRU- PTV reporting dose.

Key words:- Brain, Breast, DAO, IMRT, Optimization

0086

THE POTENTIAL PALLIATIVE ROLE AND POSSIBLE IMMUNE MODULATORY EFFECTS OF LOW-DOSE TOTAL BODY IRRADIATION IN RELAPSED OR CHEMO-RESISTANT NON-HODGKIN'S LYMPHOMA

Nahla El Sharkawy
NCI, Cairo, Egypt

In a group of 35 patients with relapsed and/or chemo-resistant non-Hodgkin's lymphoma (NHL), low-dose total body irradiation (LTBI) (+involved-field radiotherapy to bulky sites) achieved a complete remission rate of 29%, 2-years progression-free survival of 32% and a median progression-free survival of 12 months. The 2-year survival was 42% and the median survival was 17 months. Immuno-staining and flow cytometry of peripheral blood in 14 patients showed that LTBI leads to a significant increase in the percentage of CD4+ cells with a consequent significant increase in the CD4+/CD8+ ratio. High

lymphocytic percent and a high percentage of CD4+ cells before LTBI were significantly correlated with longer response duration and overall survival. These data may suggest that the palliative potential of LTBI should be investigated as an alternative to chemotherapy in NHL patients. The pre-treatment percentage of lymphocytes and CD4+ cells may be used as predictors for response to LTBI.

0108

Helical tomotherapy for craniospinal axis radiation in children: a dosimetric comparison with 3D conformal radiotherapy

Muhammad Adeel Ilyas, Yasser Khafaga, Rana Mahmood, Belal moftah, Mamoun Shehadeh
King Faisal Specialist Hospital and Research Centre, Riyadh, Saudi Arabia

BACKGROUND:
For medulloblastoma, 3D conformal radiotherapy (3DRT) is routinely used for delivering craniospinal axis radiotherapy treatment. In this study, we compared the dosimetric results for helical tomotherapy (HT) plan with traditional 3DRT plan for this treatment.

MATERIAL AND METHODS:
HT and 3D RT plans for craniospinal axis treatment were generated for an 11 year old child having anaplastic medulloblastoma. The planning target volume (PTV) included treating the whole brain and spine to a dose of 36 Gy, followed by a sequential brain posterior fossa boost of 18 Gy using 1.8 Gy daily fractions (Total dose 54 Gy). Treatment plans were evaluated using standard dose-volume histograms and dose to organs at risk (OAR) were compared.

RESULTS:
HT resulted in lower dose to parotids (Dmean 17.5 Gy HT vs. 43 Gy 3DRT), lens (Dmax 5 Gy HT vs. 13 Gy 3DRT), Thyroid (Dmean 7.5 Gy HT vs. 9Gy 3DRT), Heart (Dmean 10 Gy HT vs. 17 Gy 3DRT) and Esophagus (Dmean 18 Gy HT vs. 28 Gy 3DRT). The dose to the kidneys and lungs were comparable in both the treatment plans.

CONCLUSION:
In children, HT offers better sparing for midline OAR. However there was no advantage of HT for sparing the kidneys and lungs. Moreover, HT avoids the potential errors that may result from beam matching and setup technicalities required for 3DRT craniospinal treatment.

0113

Global fight against cancer: Implementation of lung SBRT program in developing countries through International cooperation

Jamal Khader[1], Shada Wadi-Ramahi[2,1], Abdelatif AlMousa[1], Samer Alheet[1], Imran Rashdan[1]
[1]*King Hussein Cancer Center, Amman, Jordan,* [2]*King Faisal Specialist Hospital and Research Center, Riyadh, Saudi Arabia*

Background: Lung cancer is the most common cancer in adults in Jordan. Whereas most cases of non-small cell lung cancer(NSCLC) were diagnosed with stage III-IV, recently more stage I-II are diagnosed. Stereotactic-body-radiotherapy(SBRT) is considered standard-of-care for inoperable NSCLC. This procedure needs to be implemented with care especially where resources are sparse and collaboration between centers in developing and developed countries is crucial. We discuss steps taken for implementation for SBRT at our center through collaboration with MD Anderson Cancer Center(MDACC). Method: Following the collaborative agreement an on-site hands-on training workshop was organized and

later an overseas training visit was scheduled. Our equipment consists of Pinnacle® TPS, Big-Bore CT and Elekta Precise-series linac. MDACC provided overview and feedback on commissioning, clinical procedures, 4DCT for respiratory management and PET/CT for delineation. The overview continued for the first few cases of SBRT patients treated and was considered as a form of peer-review, in which dose fractionation, beam geometry and dosimetrical issues where discussed via electronic correspondence. Institutional protocols for clinical and physics issues were written and approved. It should be noted that for implementation of such procedures, the expertise of the local staff chosen to liaise with the collaborative institution is important to assure proper transfer of knowledge.

Results and Conclusion: Successful implementation and treatment of inoperable NSCLC patients using SBRT in Jordan was achieved as a result of knowledge transfer and cooperation. Global fight against cancer dictates the need for international collaboration more so in resource-limited countries for the non-conventional radiotherapy procedures.

0123

A new tissue-equivalent phantom applied to radiotherapy treatment: a feasibilty study

Mohammad Aljamal
Arab American University, Jenin, Occupied Palestinian Territory

The aim of this project is to evaluate the feasibility of using olive wood as tissue-equivalent material instead of Perspex material for PDD and beam profile measurement. The mass density of olive wood was determined based on Archimedes' principle. Monte Carlo simulation was also carried out to calculate percentage depth dose (PDD) and beam profiles in the simulated olive wood phantom to verify the data calculated using simulated water phantom for the same field size. It was found that the mass density of olive wood was 1024 kg m^{-3}, which is very close to mass density of water. The PDD and beam profile calculated using simulated olive wood phantom agreed very well with that calculated using simulated water phantom. In conclusion, the results showed that the olive wood material is water-equivalent material based on density measurement and montecarlo simulation calculation and it could be used as phantom for radiotherapy dose verification instead Perspex phantom.

0126

Commissioning and Validation of Elekta HD Versa Linear Accelerator and Beam Model: KFSHRC/KAUH Jeddah Experience

Lookman Adeleke Abdullah[1], Naseem Hussein[1], Meteb A[2], Ayman Bokhari[2], Camilia Constantinescu[1]
[1]King Faisal Specialist Hospital and Reasearch Center, Jeddah, Saudi Arabia, [2]King Abdulaziz University Hospital, Jeddah, Saudi Arabia

We recently commissioned a new clinical HD VERSA linear accelerator (LINAC) from Elekta at King Abdulaziz University Hospital/ King Faisal Specialist Hospital and Research Center, Jeddah. The LINAC consist of 5 photons (2 with Flattening Filter Free modes) and 4 electron beam energies coupled with the XVI imaging guidance system and the Hexapod 6-D couch system. The beam calibration of the LINAC was performed using the TRS 398 calibration protocol and several data such as percentage depth dose and profiles and other dosimetry metrics of interest were obtained. The beam model was generated and benchmarked with measurements according to Elekta recommendations using test beams incorporated into our MONACO planning system and Mosaiq record and verify system. The plan versus measurement comparisons was done using the 729 Octavius 2D Array Dosimeter from PTW. We also completed end to end checks using real clinical cases to ensure the accuracy and validity of our beam model. In this contribution, the results of the successful beam commissioning and validation of the HD Versa is presented.

0148

Comparison of Two Atlas-based Segmentation Methods for MRI-based Adaptive Brachytherapy for Cervix Cancer with MR image Standardization Strategy

Habib Al saleh, Eric Paulson
Medical Collage of Wisconsin, Milwaukee, WI, USA

Purpose:

MR images acquired per fraction for Cervix Cancer Adaptive Brachytherapy poses variation in signal intensity caused by imperfections of the image acquisition process. This artifact challenges atlas-based segmentation algorithms used for auto contouring in radiation therapy. The aim of this work is to demonstrate an improved auto-contouring method with MR image standardization strategy.

Methods:

3D T2 SPACE images of nine patients undergoing MRI-based ABT at 3T were used here. MR image standardization performed in a series of three sequential steps: 1) image intensity non-uniformities (IINU) correction using the MNI N3 algorithm, 2) noise filtering using anisotropic diffusion, and 3) signal intensity normalization. Patient-specific cumulative MR atlases of bladder, rectum, and sigmoid contours were constructed from all previous ABT fractions. Auto-contouring was performed in MIM (v6.4.5, MIM Software) in two ways: 1) best-match of one atlas image to the daily image, 2) multi-match of all previous fraction images to the daily image. Dice's Similarity Coefficients (DSCs) were calculated for auto-generated contours relative to reference contours.

Results:

DSCs consistently increased for auto-contoured bladder, rectum, and sigmoid following MR image standardization. The highest DSCs detected when the combination of MR image standardization and multi-match cumulative atlas-based auto-contouring was utilized with average DSC of 0.79 +/-0.11, 0.65 +/-0.11, 0.55 +/-0.15 for bladder, rectum and sigmoid respectively for standardized multi-match compared to 0.72 +/-0.15, 0.57 +/-0.16, 0.44 +/-0.15 for original best-match.

Conclusion:

Multi-match atlas-based segmentation with standardized MR images improved the accuracy of auto-contouring for cervix cancer ABT and produced the highest DSCs.

0150

Evaluation of mucositis in head and neck cancer patients receiving radiation therapy

Maha Alsubaie[1,2], Muslahah Alharthi[1,2], Maram Alharbi[1,2], Riham Elsayed[1]
[1]*Princess Noura University, Riyadh, Saudi Arabia,* [2]*King Fahad Medical City, Riyadh, Saudi Arabia*

Introduction: Clinical studies have focused on mucosal toxicity associated with cancer therapy, which is a common acute toxic effect of radiotherapy in head and neck cancer patients **[14].** mucositis occurs in near all patients who receive head and neck radiotherapy to the oral cavity or oropharynx **[14].** Mucosal injuries may result in breaks in treatment, the placement of feeding tubes, and hospitalization. Which may affect the patient's quality of life and compromise the treatment outcome **[22].**

Objectives: To determine the severity of mucositis in patients receiving radiotherapy for head and neck cancer.

Material and Methods: Data regarding 25 male and female patients between 18-70 years old with head and neck tumors who had received radiation therapy are collected via chart review at Radiation Oncology Department in King Fahad Medical City.

Result: Data were obtained for 25 head and neck cancer patients.Primary tumor locations were nasopharynx(36%),oropharynx(4%),tongue(4%),hypopharynx(12%),larynx(20%),thyroid(8%)and Hodgkin lymphoma (16%) . The majority of tumors were classified as Stages III or IV. The majority of patients (64%) received conventional radiation therapy. Factors that were found to be significantly associated with an increased risk of mucositis in the study is primary tumor location, stage and chemotherapy.

Conclusion: We believe the current study confirms that mucositis is a common complication among head and neck cancer patients. Which may affect the quality of life and interfere to a great extent with the outcome of cancer treatment .Because the treatment of mucositis is limited, prophylaxis is emphasized. Patient education with regard to oral hygiene is important.

0153

Improved Auto Contouring Method of Hyperintense Vasogenic Edema Lesions on FLAIR MRI

Habib Al saleh, Eric Paulson
Medical Collage of Wisconsin, Milwaukee, WI, USA

Purpose:

Manual contouring of vasogenic edema (VE) lesions is tedious and time consuming. However, the performance of the auto-segmentation algorithms are challenged with MR images due to inhomogeneity non-uniformity artifacts. In this work we demonstrate an improved accuracy of auto-segmentation of lesions in FLAIR MR images with standardization strategy.

Methods:

FLAIR MR images for four patients with VE lesions were selected for this study. Standardization of the MR images consisted of: 1) IINU correction using the MNI N3 algorithm, 2) noise filtering using anisotropic diffusion, and 3) SI normalization using the volumetric median. VE lesions were manually contoured in the original images and transferred to standardized images for comparison. Constant threshold tool in MIM (v6.4.5, MIM Software, Cleveland, OH) used to auto-segment the lesions with the threshold set to median + 1.75 of standard deviation over brain contour. The accuracy of the auto-segmentations was compared to the manual segmentations using the Similarity Coefficients (DSC) and the Hausdorff Distance (HD).

Results:

Standardized FLAIR images demonstrated 19% improvement in auto-contouring accuracy over original images with average DSC of 0.62 +/-0.09 for standardized compared to 0.52 +/-0.16 for original. Additionally, standardized images showed better HD than original with a mean difference of 0.99mm between manual and auto-segmentation for standardized compared to 2.2mm for original.

Conclusion:

Standardization improves MR image uniformity and auto-contouring accuracy. While still requiring some editing, this method of auto-segmentation with the standardization strategy shows promise for decreasing the contouring time required for brain cancer in RT.

0156

The Late auditory toxicity of radiotherapy for nasopharyngeal carcinoma .

Tarfah Aljuaythin[1,2], Ala Alkarji[1,2], Manal Alkhaldi[1,2], Riham Elsayed[1]
[1]Princess Noura University, Riydah, Saudi Arabia,[2]King Fahad Medical City, Riydah, Saudi Arabia

Introduction :The most common head and neck cancer is nasopharyngeal carcinoma (NPC) which represents up to 6% of all malignancies detected yearly in Saudi Arabia . Radiation therapy is the standard treatment for nasopharyngeal carcinoma. Radiotherapy induced auditory toxicities resulting from the cochlear damage, is one of the major long term side effects which impacts the patients' quality of life.

Objective : evaluation of the auditory toxicity of radiation therapy to the NPC

Method and Material : A retrospective descriptive study was included 25 patients with NPC received at RT King Fahad Medical City. Th patients with stage 1-4, both male and female patients between age 24-77years were included .And the Patients with impaired hearing before RT were excluded. 25 audiogram reports were evaluated 12 months after completing radiotherapy .A questionnaire was offered for the patients and the data analysis was done using SPSS Program , t-test and Chi-square test

Results: Our study showed the patients who received radiotherapy to nasopharynx were suffered from various degrees of hearing loss. Our patients were suffered from the SNHL in right ear, its incidence was highly significant compared to the left ear.In Questionnaire analysis, we found that 40% of patients had experience ears hurt and drain fluid.There was a highly significant difference between males and female response .

Conclusion: Hearing loss can happen in considerable proportion of patients undergoing radiotherapy for nasopharyngeal carcinoma .The patient must be advised to mentally prepare him for any post-irradiation hearing loss situation.