with low tumor expression of osteopontin could elect to receive less toxic, standard dose RT.

2019 POSTER DISCUSSION

Early clinical outcome of simultaneous modulated accelerated radiation therapy (SMART) intensity modulated radiotherapy (IMRT) for nasopharyngeal Carcinoma (NPC) in Queen Elizabeth Hospital (QEH), Hong Kong

F. Cheung[1], S.F. Liu[2], K.C. Ngan[1], F. Lee[2], C.L. Chan[2], K.H. Wong[1], S.K. Au[1], C.K. Law[1]. *[1]Queen Elizabeth Hospital, Clinical Oncology, Hong Kong, Hong Kong; [2]Queen Elizabeth Hospital, Medical Physics, Hong Kong, Hong Kong*

Background: Radiotherapy is key component of NPC standard treatment. IMRT dosimetric advantage is observed by various authors. SMART escalates the physical dose in tumor without prolonging treatment thereby conferring radiobiological advantages. IMRT was introduced in QEH for NPC in 2003 for either as boosting or full course treatment. This retrospective review on whole course SMART IMRT treated NPC patients analyzed clinical endpoints of local control (LC), regional control (RC), metastasis-free survival (MFS), overall survival (OS), and progression free survival (PFS), as well as complications. Dose prescribed to NP is 66 Gy in 33fractions in 6 1/2 weeks.
Material and Methods: Total 94 patients (pts) from 2003 to 2006 were stratified according to age, sex, T, N and stage. Overall 15, 4, 15, 23 and 37 pts had stage T1, T2a, T2b, T3, and T4 cancers respectively. 58, 13, 20, and 3 pts had N0, 1, 2 and 3 diseases respectively. 13, 4, 13, 26, 35, and 3 pts had stage I, IIa, IIb, III, IVa and IVb disease respectively. 30.8%, 26.6% and 8.5% pts had neoadjuvant, concurrent and adjuvant platinum based chemotherapy respectively.
Results: Median age was 52 (range: 13−77). Median of mean dose to GTV NP and GTV neck nodes was 72.7 Gy and 70.5 Gy respectively. 22.3% and 4% pts experienced grade 3 mucosa and skin acute toxicity. 4 and 1 pts had locally and regional persistent disease respectively. At a median follow-up of 30.4 months, 3 year (3 yr) LC, RC, MFS, PFS and OS were 91.2%, 97.7%, 90.5%, 78.7% and 83.8% respectively. Altogether, 9 (9.6%) and 2 (2.1%) pts had local and regional relapses respectively. 3 yr LC for T1, T2, T3 and T4 were 84.6%, 100%, 95.5%, and 82.8% respectively. 3 yr MFS for stage I to IVb was 100%, 100%, 73.8%, 92%, 86.8% and 66.7% respectively; 3 yr PFS for stage I to IVb was 75.5%, 100%, 73.8%, 84.4%, 64.5% and 66.7% respectively; 3 yr OS for stage I to IVb was 92.3%, 100%, 87.5%, 92.3%, 76%, and 50% respectively. 3 pts had choking or dysphagia during and after treatment and needed tube feeding. 2 T4 pts without active cancer died of massive epistasis within 6 months after RT completed. One T4 pts had temporal lobe necrosis 3 yrs after chemoradiation. 3 had noticeable hearing loss and 1 developed hypothyroidism. T4 stage was the only significant factor in univariate analysis of OS and PFS.
Conclusion: This report demonstrated SMART IMRT treatment results were on par with conventional RT results of our institute and IMRT results in published series. The lower T1 LC can be explained by the small number of cases in the group. Improvement in metastasis control in stage IVb is a major challenge.

2020 POSTER DISCUSSION

Is 18F-FDG a surrogate tracer to measure tumor hypoxia? Comparison with the hypoxic tracer 14C-EF3 in animal tumour models

N. Christian[1], S. Deheneffe[1], A. Bol[1], M. De Bast[1], D. Labar[1], J.A. Lee[1], V. Gregoire[1]. *[1]Université Catholique de Louvain, Center for Molecular Imaging and Experimental Radiotherapy, Bruxelles, Belgium*

Background: Fluorodeoxyglucose (FDG) has been reported as a surrogate tracer to measure tumor hypoxia with Positron Emission Tomography (PET). The hypothesis is that there is an increase uptake of FDG under hypoxic conditions as a consequence of an over-expression of the glucose transporters Glut-1 and Glut-3. However, the sensitivity and specificity of FDG to measure hypoxia has never been studied. This study aimed to compare the tracers ^{14}C-EF3 and ^{18}F-FDG to detect hypoxia in mouse tumor models.
Material and Methods: C3H tumour-bearing mice (FSAII and SCCVII tumors; mean diameter of 10−12 mm) were injected with ^{14}C-EF3, and 1 h later with ^{18}F-FDG. Using a specifically designed immobilization device with fiducial markers, PET (Mosaic®, Philips) images were acquired one hour after the FDG injection. After imaging, the device containing mouse was frozen, transversally sliced and imaged with autoradiography (AR) (FLA-5100®, Fujifilm) to obtain high resolution images of the ^{18}F-FDG distribution within the tumor area. After a 24 h delay allowing for ^{18}F decay, a second AR was performed to image ^{14}C-EF3 distribution. AR images were aligned to reconstruct the full 3D tumor volume, which could be compared with the PET images. Image segmentation with threshold-based methods was applied on both AR and PET images to derive various tracer activity volumes. A Dice matching index was then computed. The comparison was performed under normoxic (ambient air, FSAII: n = 4, SCCVII, n = 5) and under hypoxic conditions (10% O_2 breathing, SCCVII: n = 4).
Results: On AR, under both ambient air and hypoxic conditions, there was a decreasing similarity between ^{14}C-EF3 and FDG when higher activity regions were considered. Under normoxic conditions, when comparing the 10% of tumor voxels with the highest ^{18}F-FDG or ^{14}C-EF3 activity, a Dice index of 0.20 and 0.19 was found for FSAII and SCCVII, respectively. Under hypoxic conditions, a DICE index of 0.31 was observed for SCCVII tumors. When comparing the AR images with ^{14}C-EF3 with the corresponding ^{18}F-FDG-PET images, the Dice index reached values of 0.26, 0.17 and 0.16 for FSAII and SCCVII under normoxia and SCCVII under hypoxia, respectively.
Conclusion: This study showed that FDG is not a good surrogate tracer for tumor hypoxia either under ambient or hypoxic conditions. Only specific hypoxia tracers should be used to measure tumor hypoxia.

Poster presentations (Wed, 23 Sep, 09:00−12:00)
Radiotherapy and radiobiology

2021 POSTER

Imaging tumour hypoxia: the need to combine techniques

M.R. Horsman[1], T. Nielsen[1], L. Østergaard[2], T. Tramm[1], M. Busk[1]. *[1]Aarhus University Hospital, Department of Experimental Clinical Oncology, Aarhus, Denmark; [2]Aarhus University Hospital, Department of Neuroradiology, Aarhus, Denmark*

Background: Hypoxia in tumours influences radiotherapy outcome. Various non-invasive approaches are now under clinical evaluation to measure this hypoxia prior to irradiation and thus predict response. This preclinical study demonstrates that only a combination of these techniques will accurately reflect hypoxia.
Material and Methods: C3H mammary carcinomas (200 cubic mm) grown in the foot of female CDF1 mice were locally irradiated under normal or clamped conditions and percent tumour control determined 90 days later. Radiobiological hypoxic fraction was calculated from the dose-response curves. Additional mice were intraperitoneally (ip) injected with pimonidazole (PIMO) and then subjected to dynamic contrast enhanced-magnetic resonance imaging (DCE-MRI) performed on a 3-tesla magnet following intravenous injection of gadolinium-DTPA. At 90 minutes post PIMO injection the tumours were excised and from histological sections the PIMO distribution determined by immunohistochemistry. All procedures were performed under control conditions or following ip injection of nicotinamide (acute hypoxia modifier) or carbogen breathing (chronic hypoxia modifier).
Results: The mean (with 95% confidence limits) radiobiological hypoxic fraction for control tumours was 23% (15−31). This was significantly (Chi-squared test; $p < 0.05$) reduced to 7% (3−12) by nicotinamide and 6% (3−9) by carbogen. Mean (with 1 S.E.) hypoxic fractions measured by PIMO labelling were 8.1% (6.4−9.9), 8.1% (6.1−10.2), and 1.4% (1.3−1.5) in controls, nicotinamide, and carbogen treated animals, respectively; only the carbogen group showed a significant change (Student's t-test; $p < 0.05$). Various DCE-MRI parameters were measured including IAUC, ktrans, kep, ve, and vp. The only parameters that showed significant (Student's t-test; $p < 0.05$) differences to those measured in controls were in the nicotinamide treated groups.
Conclusions: The radiobiological hypoxic fraction in this tumour model was reduced by both nicotinamide and carbogen, confirming that the hypoxia was both acute and chronic in nature. Changes in PIMO labelling was only seen following carbogen treatment, thus PIMO and probably other PET related hypoxia markers can only detect chronic hypoxia. Conversely, changes in DCE-MRI parameters were found only after giving nicotinamide, confirming that such "perfusion" markers primarily detect acute hypoxia. Thus, measurements of total hypoxia in tumours require combining different assays.