Most of the patients have been treated for acute leukemia with allogeneic transplant.

EP-1676
Sparing potential of scanned protons for the treatment of intramammary nodes in breast radiotherapy
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Purpose or Objective: Breast cancer patients are among the long-term survivors of radiotherapy and therefore the long-term cardiopulmonary toxicity due to the treatment should be reduced to a minimum. However, complication rates could be further increased when intramammary nodes are included in the target due to their proximity to the heart and the lungs. Several techniques could be used to decrease the dose to the normal tissues and consequently the rates of late complications, including proton beam radiotherapy and respiratory gating. This study aims to investigate the potential for normal tissue sparing for the treatment of intramammary nodes in breast cancer radiotherapy using scanned proton beams with or without respiratory gating.

Material and Methods: The study was performed on CT-datasets acquired from ten left-sided patients during enhanced inspiration gating (EIG) and free-breathing (FB). The patients were planned with intensity modulated proton therapy (IMPT) for locoregional breast treatment. The prescribed dose to the target was 50 GyRBE in 25 fractions, assuming an RBE of 1.1. Different plans were performed for breast and supraclavicular nodes respectively breast, supraclavicular and intramammary nodes (IMM). The implications of including IMM in the target volume were evaluated from the point of view of the doses to the organs at risk for cardiopulmonary complications.

Results: Inclusion of the IMM in the target volume led to a small increase of the cardiopulmonary burden. Thus, in FB cases the average dose to the heart increased from 0.3 to 0.4 GyRBE and the average dose to the lung increased from 6.1 to 6.6 GyRBE, while the average dose to the left anterior descending artery (LAD) decreased from 4.1 to 3.8 GyRBE. For EIG cases the average dose to the heart was almost unchanged (0.2 GyRBE), the average dose to the lung increased from 6.9 to 7.4 GyRBE and the average dose to the LAD decreased from 3.3 to 2.6 GyRBE. Other dosimetric parameters of interest showed a similar trend when IMM were included in the target. These parameters are much lower than those that could be achieved in conventional radiotherapy with photons, especially with respect to the cardiovascular burden, irrespective of whether respiratory gating is used or not.

Conclusion: The results of this study indicate that radiotherapy with scanned proton beams has the potential of significantly limit the cardiopulmonary burden compared to photon RT when including the IMM in breast cancer radiotherapy.

EP-1677
Comparison of different techniques in lung SABR using VMAT with deep inspiration breath hold
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Purpose or Objective: Stereotactic ablative radiotherapy (SABR) for the lung primary and metastatic tumors aims to increase the local control, survival and quality of life. Deep inspiration breath hold (DIBH) using 4D CT for simulation minimizes respiratory motion and reduces the toxicity risk by decreasing margins. In this study, we aimed to compare the dosimetric results of different devices and techniques of SABR using volumetric arc therapy (VMAT) with DIBH in the lung tumors.

Material and Methods: CT datasets of 7 patients with right-sided lung cancer performed with RPM system (Varian, Palo Alto) was used. Median PTV was 13.2 cc. Dose prescription objective was to cover 98% of the target volume by D98%, which was 50 Gy/5 fractions. Four different VMAT plans were made on Eclipse TPS (Varian, Palo Alto) using AAA algorithm. Plan A consisted of TrueBeam,120HDMLC, 6MV-FFF, without jaw tracking, Plan B TrueBeam,120HDMLC, 6MV-FFF, with jaw tracking, Plan C TrueBeam,120HDMLC, 6MV, without jaw tracking, Plan D with Trilogy, 120MilleniumMLC, 6MV, without jaw tracking. Three partial arcs using 210 degrees were used to generate the plans under the same optimization conditions. Monitor Unit (MU), beam-on time (BOT), Gradient Index (GI), lung V20 and V5, dose at 2 cm from PTV (D2cm), PTV(Dmax) and PTV(Dmin) were assessed for comparison. Wilcoxon test was used for statistical evaluation.

Results: No statistically significant differences were found for total MU, D2cm and PTV(Dmin) between the four plans. Mean PTV(Dmax) values were lower in Plan C with HDMLC compared to Plan D with MilleniumMLC (122.9±3.9 vs 126.8±3.7, p=.018). At GI assessment; there was no significant difference between plans with and without jaw-tracking. However, there was a significant difference between Plan C and Plan D (4.2±0.4 vs 4.4±0.5, p=.018). V20 and V5 was lower in Plan C compared to Plan D (2.8±1.5 vs 3.3±1.5, p=.028 and 15.1±5.3 vs 16.0±5.6, p=.018). V5 was lower in Plan C compared to Plan (14.4±5.1% vs 15.1±5.3). BOT was significantly shorter between Plan A and Plan C (167.3 sec±20.4 vs 390.5 sec±47.8, p=.018).

Conclusion: In SABR with VMAT using DIBH, we observed some improvements by using HDMLC compared to MilleniumMLC and FFF compared to FF beams. However, we could not observe additional benefit with jaw tracking in the FFF mode. Major advantage of FFF was the shorter BOT, which may finally improve the patient compliance in SABR using DIBH technique.
Results: The mean GTV volumes ranged from 149.44 to 526.33 cc. VMAT plans show good results in comparison with 3D CRT in both conformity index (0.81±0.09 Vs 0.68±0.07 respectively, p-value= 0.009), and heterogeneity index (0.11±0.03 Vs 0.14±0.02, p value= 0.042). Furthermore, minimum doses to PTV in VMAT plans are higher than 3D CRT plans (57±1.22 Vs 55.1±0.86, p value= 0.001).

In risk structures, the lung volume receiving 10Gy, 20Gy and 30Gy were reduced in VMAT plans (with relative reduction of 2.2%, p<0.002; 4.87%, p<0.001; 11.8% respectively). Mean lung was also reduced ( 15 Vs 17.69 ) but not statistically significant. V30 of the heart was reduced compared to 3D CRT (7.53±6.2 10.43±6.8 with p value of 0.051). The maximum dose of esophagus with VMAT was 47.7 Vs 48.69 with 3D CRT (not statistically significant). Moreover, D 50 of the esophagus was less with VMAT ( 19.94 Vs 23.63) with p value of 0.22.

Regarding monitor units, the mean values were (461.40±124.42 Vs 227.90±13.52) for VMAT and 3D CRT respectively.

Conclusion: Inspite of large PTVs included in our study VMAT planes showed tendency toward reduction of mean and high lung dose and heart doses. Reduction in esophageal doses was not statistically significant. This was obtained without impairment of PTV coverage that was improved in some cases. VMAT for advanced lung cancer can help to improve therapeutic ratio and may open the door for dose escalation.

Overall HT plans achieved excellent PTV coverage with mean V95 of 33.5 Gy for medulloblastoma patients. The mean V95 was 28.3 Gy for those with a haematological diagnosis. The mean homogeneity index was 1.0. Organs at risk doses were well below tolerances required. In particular averaged mean heart dose was 10.9±1.3, mean lung dose was 8.6±2.2 and mean liver dose was 9.8±1.2. The mean D50% for lung was 7.2 Gy±3.8 and mean D10% was 20.2±3.6. The mean D50% for the heart was 10.1 Gy±1.3 and mean D10% was 14.7±2.1.

Conclusion: HT for CSI has many advantages including: the ability to treat patients in supine position, no need for junctions, excellent PTV coverage, low doses to OAR and shorter treatment time.

Material and Methods: Retrospective analysis of treatment planning and dosimetric indices was undertaken on seven patients who received craniospinal radiotherapy with HT at our centre. The HT plan was delivered using 51 beam angles per rotation, with a constant modulation factor of 2.0, field width of 5 cm and one of two pitches (0.43 or 0.28) to optimise treatment plans. An iterative inverse planning algorithm based on least squares minimisation was used which optimises multi-leaf collimator at each beam angle. Dose was calculated by convolution and superposition. Patients were imaged daily covering different areas of the body and corrections applied for directional errors. Data analysis was done using descriptive statistics.

Results: Helical tomotherapy plans for seven adult patients were analysed. Five patients had a haematological malignancy and two had a medulloblastoma. Five patients with a haematological diagnosis received a dose of 300Gy in 1.5Gy/#. Two patients with medulloblastoma received 35 Gy delivered in 1.67Gy/+. Details of treatment planning and plan evaluation parameters of seven patients are presented in Table 1.