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Comparison of two techniques for irradiation of the breast and the regional lymphatics - helical tomotherapy and 3D conformal radiotherapy

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Purpose:

The breast cancer is the most common malignancy among women in our country. In the National Hospital of Oncology we have been treated about 600 patients per year.

The purpose of the study is to present treatment planning protocols for left and right site breast irradiation, when the planning target volume include the involved breast (PTV), and supraclavicular lymph nodes (PTV_SCLN) using helical tomotherapy and to compare with “one isocenter” 3D conformal radiotherapy.

Methods and Materials:

The irradiation was planned for 10 real patients with left and 10 with right breast cancer using “one isocenter” technique, which is our protocol for irradiation with an isocenter situated at the lower edge of the supraclavicular part of the target volume, and asymmetrically irregularly MLC collimated beams. Tomo Helical plan was developed for the same patients using field with -5.048 cm, pitch 0.22 cm and Modulation Factor 3. The fall-off of the dose was controlled by help contours at a distance of 1.5cm from PTV and PTV_SCLN. Directional blocking was applied to the heart and contralateral breast and lung.

The planned total treatment dose was 50 Gy for both PTV and PTV_SCLN. The critical organs were: contralateral breast, ipsilateral and contralateral lung, heart and liver.

For evaluation dose volume histograms were used.

Results:

The average results with standard deviation (SD) for Tomo helical and 3D CRT plans are presented in Table1. The averaged minimum dose for PTV in 2 ccm ($D_{min2ccm}$) increased from 25.9 ± 6 Gy for 3D plans to 39.7 ± 1 Gy for tomo helical and for PTV_SCLN from 37.8 ± 1.6 Gy to 45.4 ± 0.6 Gy. The maximum dose in 2ccm ($D_{max2ccm}$) decreased for PTV from 54.51 ± 0.6 Gy for CRT plans to 52.7 ± 0.4 Gy for tomo, and from 55.2 ± 0.6 Gy to 51.8 ± 0.2 Gy for PTV_SCLN. The homogeneity index ($HI=(D_{(2\%)}-D_{(98\%)})/D_{mean}$) was $HI_{PTV_tomo} = 0.09 \pm 0.01$; $HI_{PTV_SCLN_tomo} = 0.06 \pm 0.01$, respectively $HI_{PTV_3DCRT} = 0.29 \pm 0.04$ and $HI_{PTV_SCLN_3DCRT} = 0.23 \pm 0.05$. The conformity index for PTV+PTV_SCLN ($CI=V_{(98\%)} / V_{PTV}$) was $CI_{Tomo} = 1.03 \pm 0.1$; $CI_{3DCRT} = 0.94 \pm 0.1$.

For both techniques, ipsilateral lung received the same middle dose - 13 Gy (+0.3Gy; -0.7 Gy), the volume obtained 30 Gy was 8.5% higher in the CRT plans but the dose received in 65% of the lung volume was 3 Gy more for Tommo helical.

The middle dose for contralateral lung was 3.5 Gy lower for 3D CRT (1.2 Gy vs 4.8 Gy). Heart's average dose for left breast cases was 5 Gy greater for helical plans, but in 3D CRT plans D_{max} was 10 Gy more and V_{30Gy} was 3.6% vs 0.6%. The average dose in contralateral breast was 2.5 Gy more in tomo helical plans. The liver in right breast cases with 3D CRT plans got 5 Gy less average dose but 7 Gy more for D_{max} .

The average irradiation time for 3D CRT with gantry rotation was 5.2 minutes, for tomo helical - 6.5.

Conclusion:

The conformity and homogeneity of PTVs were better for helical tomotherapy plans than the 3D CRT for both left and right breast tumor with regional lymph node involvement. The organs at risk: ipsilateral lung, contralateral lung, contralateral breast, heart and liver received a higher average dose in tomo helical plans, but lower maximum dose and a low dose in adjacent to PTVs part of their volume. There was no significant

difference in irradiation time.

Key words: Treatment planning, Breast cancer, 3D conformal radiotherapy, Helical tomotherapy

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