

		Number of patients (%)
T stage	pTis	4 (6)
	pT0	2 (3)
	pT1a	3 (4)
	pT1b	24 (36)
	pT1c	20 (29)
	pT2	3 (4)
	pT3	1 (1)
	pT4b	2 (3)
	pT4d	9 (12)

Conclusions: This system based on artificial intelligence automatically enables the classification of tumor size in BC. Among the data mining algorithms, the J48 algorithm had the highest percentage of correctly classified cases and allows changes (i.e.: guideline updates). This tool would save time in the data collection, prevent errors, and improve tumor classification as well as the quality of the therapeutic decision.

EP-1050

Reduction of heart and lung dose with gated radiotherapy in left breast cancer: an analysis on 71 patients

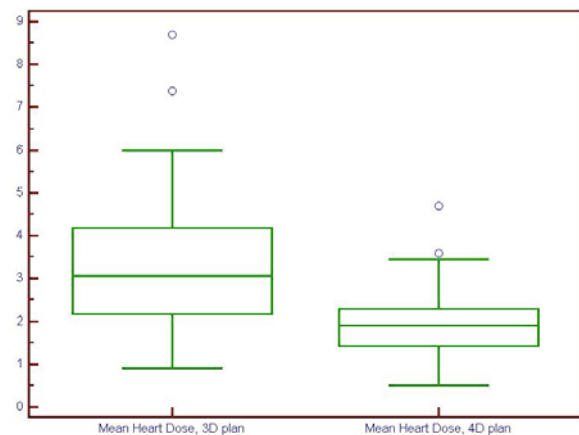
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Purpose/Objective: Breast conserving surgery and post-operative whole breast radiotherapy (RT) have proved to reduce local recurrence and improve survival of early stage breast cancer patients. On the other hand, it has been demonstrated that long-term survivors have a significantly higher risk of lung complications and cardiac death as a consequence of heart and lung irradiation during tangential breast RT. Respiratory gating RT provides a chance to reduce heart and lung doses. This study evaluates the cardiopulmonary dose sparing of a prospective-gating RT for left breast cancer using a four-dimensional computed tomography (4DCT) technique.

Materials and Methods: Patients with early left breast cancer, referred for adjuvant radiotherapy to our Institution, were enrolled in this study. For each patient, two simulation CT-scans were acquired: the first during free breathing and the second on prospective gating during deep inspiration breath-hold. The scans were monitored by the Varian RPM™ respiratory gating system. Whole heart and pericardium was contoured starting superiorly just below the left pulmonary artery. For each patient, two treatment plans, based on the two CT studies, were performed with conformal tangential fields. Maximum lung distance (MLD) was measured on beams eye view. Mean heart dose (MHD), heart V₂₅, ipsilateral lung V20 and V30 were evaluated. Dose-volume histograms were calculated and compared by the paired sample T-test.

Results:



From January to November 2012, 71 patients were enrolled. Median age was 50 years (range 30-76), the mean breathing period was 4.3s (range 2-12.9), and the mean 4DCT scanning time was 12.2 s (range 5-19). Overall patients' compliance was good. The average MHD was 3.2 Gy (range 0.90-8.70) in the 4D plans and 1.8 Gy (range 0.50-4.70) in the 3D plans ($p < 0.0001$). The mean heart V₂₅ was 2.25% (range 0-12.60) and 0.14% (range 0-3.40) for 3D and 4D plans, respectively ($p < 0.0001$). The average MLD was 2.17 cm (range 0.97-3.74) on 3D plans and 2.43 cm (range 1.25-4.0) on the 4D plans ($p < 0.0001$). The mean lung V20 and V30 were 11.28% (range 1.70-27.50) and 9.37%

(range 1.10-24.80) for 3D plans, and 9.25 % (range 3.50-20.60) and 7.89% (range 2.40-30) for 4D plans ($p < 0.0001$ and $p = 0.0035$, respectively).

Conclusions: Prospective gating tangential RT to left breast allows the delivery of a significantly lower dose to heart. The MLD was significantly higher on 4D plans, but the ipsilateral lung received an overall smaller dose of RT, as demonstrated by the significantly lower V20 and V30.

EP-1051

Adjuvant hypofractionated radiation therapy after conserving surgery for early breast cancer

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Purpose/Objective: The aim of this prospective study is to evaluate feasibility, early and late skin toxicity in women treated with hypofractionated whole breast irradiation schedule for breast cancer.

Materials and Methods: Between 2/ 2008 and 4/ 2011, 40 women with invasive early breast cancer were treated with conservative surgery followed by sentinel-node biopsy in 47.5% and axillary dissection in 40%. No axillary node surgery was performed in 12.5% of cases. The median age was 72 years (range 56-85). Histology was as follows: infiltrating ductal carcinoma 30/40 pts, infiltrating lobular carcinoma 6/40 pts, DCI and CLI 1/40 pt, others 3/40 pts. Stage was as follows: pT1 in 33 pts (82.5%), pT2 in 7 pts (17.5%). The axillary lymph nodes were negative in 77.5% and positive (pN1a) in 12.5%. Thirty-five pts received adjuvant hormone therapy and 3 pts received adjuvant systemic therapy respectively. Radiation therapy was delivered by means of two opposed tangential fields. Using the original planning computer tomography scans the entire breast and OARs were delineated. The DVH histograms were accepted just if PTV was included in ICRU constraints. All pts were treated with 6-15 MV x-rays. Median whole-breast irradiation dose prescribed was 40.05Gy (range: 40 - 42.5 Gy) administered in 15-16 fractions of 2.5-2.67Gy (5 fractions/week). Boost irradiation to the tumor bed with the doses of 2 to 3 Gy/fraction was performed in 4 cases. No attempt was made to treat the axilla or the supraclavicular or internal mammary nodes.

Results: All pts completed the schedule. The median follow-up was 18 months (range 16-54 months). All pts were routinely evaluated to register acute side effects and late skin toxicity according to RTOG criteria. At the end of treatment 50% presented grade 0 acute skin toxicity, 35% had grade 1 and 15% had grade 2. At 6 months there were 30% cases of grade 1 skin toxicity and 7.5% of grade 2. At 12 months 45% and 5% of pts presented with clinical grade 1 and grade 2 fibrosis respectively and 5% presented hyperpigmentation. At 24 months, with 21 patients evaluated, just 1 pt showed grade 2 late fibrosis. The remaining pts were free of side effects. No pts experienced local relapse, nor distant metastasis.

Conclusions: Our data showed a good feasibility of the hypofractionated schedule in terms of acute and late skin toxicity. The hypofractionated schedule shortens the overall treatment time and represents a biologically acceptable alternative to the traditional 6 weeks regime.

EP-1052

Monitoring of chemotherapy efficacy in patients with advanced breast cancer: a guide for radiotherapy planning.

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Purpose/Objective: Functional imaging is known as accurate tool for evaluation of chemotherapy (CHT) efficacy in patients (pts) with breast cancer (BC). We determine the group of patients with excellent functional response to neoadjuvant chemotherapy as a potential candidates for breast irradiation instead of mastectomy.

Materials and Methods: 50 primary pts with advanced BC (T3-4, N1-2) were included in this study. Breast scintigraphy (BS) was done before the start of CHT and after 2-6 cycles of treatment with taxane-doxorubicin based regimes ± trastuzumab. BS was performed 10-15 min after i/v injection of 740 MBq of ^{99m}Tc-MIBI. Qualitative and semiquantitative scores were used to qualify dynamic of tracer uptake

(TU). CHT efficacy were estimated as follows: progression (grade I) - increase of area and/or intensity of TU; stabilization (II) - unchanged image of BC; partial effect (III) - intermediate (30-70%) decrease in intensity and area of TU in BC; prominent efficacy (IV) - only small foci of low residual TU in BC; complete resolution (V) - TU in BC on the level of background.

Results: BS detected complete resolution of TU in primary tumor in 10 (20%) of 50 treated pts, in additional 12 (24%) cases efficacy of CHT was prominent, 15 (30%) women had scintigraphic signs of stabilization or progression of BC.

Number of CHT cycles significantly influence character of BS changes. After 2 cycles of TAC ± trastuzumab 2 of 10 patients demonstrated signs of grade IV, one - of grade III tumor response and other 7 - stabilization or progression of BC.

After 3 cycles 7 (44%) of 16 women had good (grade IV-V) efficacy of CHT, in other 9 (56%) cases scintigraphic response was moderate or poor (grade I-III).

After 4-6 CHT cycles TU uptake in primary tumor disappeared (V) or become markedly reduced (IV) in 13 (54%) of 24 patients. In 6 (25%) women BS data reflect non-significant efficacy of CHT.

Conclusions: BS performed after 4-6 cycles of TAC ± trastuzumab CHT indicate that more than a half (56%) of women with advanced BC become the candidates for breast irradiation instead of mastectomy.

EP-1053

Effect of fractionation schedule and treatment technique on cardiac doses from left breast radiotherapy

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Purpose/Objective: 1) To compare mean heart and left anterior descending coronary artery (LAD) doses from left breast radiotherapy (RT) delivered using different fractionation schedules and techniques (free breathing (FB) versus activated breathing controlled deep inspiratory breath-hold (ABC_DIBH)).

2) To define a useable surrogate variable for mean heart and LAD dose in order to facilitate plan comparison.

Materials and Methods: Sixteen patients whose hearts were within tangents based on radiotherapy planning CT scans in FB were subsequently scanned in ABC_DIBH. Heart, LAD, whole breast/chest wall and partial breast clinical target volumes were outlined retrospectively. Plans were prepared for each patient and for both techniques according to ICRU 62 criteria. DVH data for three different fractionation schedules (50Gy/25#, 40Gy/15# and 27Gy/5#) were used to determine heart and LAD NTD_{mean} and NTD_{mean} per fraction as well as the volume of heart receiving 25% of the prescribed dose (heart $V_{25\%}$) (NTD_{mean} is a biologically weighted mean of total dose to tissue normalised to 2Gy fractions using a standard linear quadratic model). In addition the maximum heart depth (MHD) was measured. The correlation between heart NTD_{mean}/NTD_{mean} per fraction and both heart $V_{25\%}$ and MHD was assessed.

Results: For 27Gy/5#, 40Gy/15# and 50Gy/25# plans respectively, mean heart NTD_{mean} for FB plans was 2.7, 3.1 and 3.5Gy ($p<0.001$) and for ABC 0.7, 0.9 and 1.1Gy ($p<0.001$). Mean LAD NTD_{mean} for FB plans was 19.4, 20.1 and 22.6Gy ($p<0.001$) and for ABC 5.7, 6.4, 7.4Gy ($p<0.001$). Mean heart NTD_{mean} per fraction for FB plans was 0.55, 0.20 and 0.14Gy ($p<0.001$) and for ABC 0.14, 0.06 and 0.04Gy ($p<0.001$). Mean LAD NTD_{mean} per fraction for FB plans was 3.88, 1.35 and 0.90Gy ($p<0.001$) and for ABC 1.15, 0.43 and 0.30Gy ($p<0.001$). Linear correlation r^2 values of 0.98 and 0.72 were obtained for the correlation between heart $NTD_{mean}/heartNTD_{mean}$ per fraction and heart $V_{25\%}$ and MHD respectively.

Conclusions: Heart and LAD NTD_{mean} decrease with the increasingly hypofractionated schedules assessed here. In contrast, heart and LAD NTD_{mean} per fraction increase with increasingly hypofractionated schedules. Heart $V_{25\%}$ is a useful and easily derived surrogate for heart NTD_{mean}/NTD_{mean} per fraction.

EP-1054

Accelerated partial breast irradiation with 3D conformal external beams - 4-year results of a phase II study

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Purpose/Objective: To report the 4-year results of accelerated partial breast irradiation (APBI) by means of three-dimensional conformal radiotherapy (3D-CRT) following breast-conserving surgery (BCS) for early-stage breast cancer.

Materials and Methods: Between 2006 and 2010, in 44 cases of low-risk, pT1-2 (≤ 30 mm) pN0 M0 breast cancer, postoperative APBI was given by means of 3D-CRT using 3 to 5 non-coplanar fields. The total dose of APBI was 36.9 Gy (9 x 4.1 Gy) using a twice-a-day fractionation over 5 consecutive days. Four-year survival results, early and late toxicities, and cosmetic results were analyzed.

Results: At a mean follow-up of 47.5 months neither loco-regional nor distant failure was observed. No patient died of breast cancer, but two of them died of internal disease. The 4-year probability of overall survival was 93.3%. Grade 2 or worse acute side-effect was not observed. Data on late toxicities and cosmetic results were available in 43 cases (97.7%). Grade 1, 2, and 3 fibrosis occurred in 22 (51.2%), 7 (16.3%), and 1 (2.3%) patients, respectively. Only 4 patients (9.3%) developed slight (grade 1) skin hyperpigmentation. No patient developed grade 2-4 late skin side effect. Asymptomatic fat necrosis was detected in 8 cases (18.6%) on follow-up mammography. Excellent, good, fair, and poor cosmetic outcome was reported in 12 (27.9%), 23 (53.5%), 8 (18.6%), and 0 (0%) patients, respectively.

Conclusions: 3D-CRT is a feasible technique for the delivery of APBI following conservative surgery for the treatment of low-risk, early-stage invasive breast carcinoma. Four-year results are promising, early- and mid-term radiation side effects are rare, and cosmetic results are excellent.

EP-1055

Delivered dose in breast cancer patients treated with vmDIBH is at least as good as in free breathing

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Purpose/Objective: Different breath movement management techniques have been described which effectively spare the heart in tangential breast irradiation. The most easy and cheapest way is voluntary moderately Deep Inspiration Breath Hold (vmDIBH), but reproducibility, and thus actual dose delivery, of this method is unclear. The aim of this study is to determine whether the 2D measured delivered transit dose is comparable for vmDIBH and free breathing (FB) breast irradiations.

Materials and Methods: Data of 11 patients irradiated during vmDIBH and 9 patients irradiated in FB were analyzed. Patients were irradiated using a forward IMRT technique to a total dose of 42.7 or 50 Gy in 16 or 25 fractions, respectively. A Shrinking Action Level (SAL) protocol was used for set-up verification using $\alpha=10$ mm and $n_{max}=3$. 2D transit portal dosimetry was performed for the tangential fields on various days, resulting in 386 and 156 measurements for the vmDIBH and FB patients, respectively. The delivered transit dose was compared to a predicted dose by calculating global gamma values with gamma criteria of 3% and 3 mm. The percentage of pixels with an absolute gamma value >1 ($\gamma>1$) was determined for each measured fraction, for both latero-medial and medio-lateral beams. Mean values of this parameter were compared between the vmDIBH and FB patient groups. Gamma images with more than 5% of the pixels >1 were classified as 'failed'. To find an explanation for these failures, these gamma images were evaluated visually. If an image showed isolated regions of both underdosage and overdosage, gamma and hence dose differences were considered to be due to a simple translation (residual set-up error or organ motion); if a gamma image showed other patterns, dose differences were considered to be due to rotation or deformation of the breast.

Results: The $|\gamma|>1$ for all patients was on average $22.0\pm 10.9\%$ (1 SD). For the vmDIBH and FB patients, these values were $22.3\pm 11.1\%$ and $21.3\pm 10.5\%$ (1 SD), respectively. No significant difference was found ($p>0.05$). 76% of the gamma images were classified as 'failed', 77% in vmDIBH patients and 73% in FB patients. In both groups, 24% of the 'failures' was attributed to translations. The $|\gamma|>1$ was $24.4\pm 11.0\%$ and $20.2\pm 9.9\%$ (1 SD) for the medio-lateral fields, respectively ($p>0.05$). For the latero-medial fields, these numbers were $22.7\pm 10.8\%$ and $24.5\pm 12.1\%$ (1 SD), respectively ($p>0.05$) (Figure 1).