



Contribution ID: 245

Type: Oral Presentation

Interfraction variation in the target volume for accelerated partial breast irradiation (APBI) using intraoperative multicatheter interstitial brachytherapy and its dosimetric impact.

Friday, June 23, 2017 11:31 AM (8 minutes)

Introduction of the study:

Multi-catheter interstitial brachytherapy (MIB) is the oldest technique with longest follow-up for Accelerated Partial Breast Irradiation. Intra operative multicatheter interstitial brachytherapy requires duration of implant in situ is generally 7-10 days which may lead to post operative changes such as seroma formation and regression. This may result in variation in the lumpectomy cavity (LC) and the planning target volume (PTV) during the course of treatment. The present work aimed to investigate the dosimetric impact of interfraction variation in the target volume during accelerated partial breast irradiation for intra-operative breast implants.

Methodology:

Intraoperative placement of flexible catheters was performed on sixteen patients who underwent computed tomography (CT1) based brachytherapy planning. The lumpectomy cavity was delineated on CT1 which included seroma, radio-opaque clips, and air in the cavity. Clinical target volume (CTV) was obtained by growing a uniform margin of 1 cm around the cavity. CTV was edited by limiting the skin by 0.5 cm and up to the chest wall. For brachytherapy CTV was considered as planning target volume (PTV). Catheter reconstruction was done on CT1 and active dwell positions of each catheter were obtained by giving a margin of 0.5 cm over CTV. Graphical optimization was done to yield optimum plan PCT1 for the treatment. CT was repeated prior to the last treatment fraction (CT2). Contouring of LC, CTV and catheter reconstruction were carried out on CT2. PCT1 was manually reproduced in CT2 which yielded plan PCT2.

Plans were compared using coverage index (CI), dose homogeneity index (DHI), external volume index (EI), overdose volume index (OI) and conformal index (COIN).

CI is the fraction of the LC or CTV receiving a dose equal to or greater than the prescription dose. EI is the ratio of the normal tissue volume outside the CTV receiving a dose equal to or greater than the prescription dose to the CTV. DHI is the fraction of breast tissues receiving a dose between 100% and 150% of the reference dose. OI is the fraction of the CTV receiving a dose equal to or greater than two times the reference dose. The COIN takes into consideration the coverage of the CTV by the prescription dose and also the unwanted irradiation of normal tissue outside the CTV. The data was compared and statistically analyzed by T-test for paired samples using Statistical Package for Social Sciences (SPSS version 20.0, IBM, Chicago) software.

Results:

The mean volume of LC and PTV was 68.02 ± 27.95 cm³ and 138.84 ± 46.93 cm³ for PCT1 while it was 74.88 ± 31.33 cm³ and 146.56 ± 55.88 cm³ for PCT2. Mean CI of LC and PTV decreased significantly by 3.74% ($p=0.024$) and 8.64% ($p=0.001$) in PCT2. 11.8% and 10% increase in the mean EI and OI was observed in PCT2. Variation in the mean DHI was small and insignificant for both plans. Significant decrease ($p=0.001$) in mean COIN value was observed in plan PCT2 (0.538) compared to PCT1 (0.602).

Conclusion:

The interfraction variation in the LC and CTV volume was found patient specific. Interfraction variation in the CTV volume has shown the significant impact on coverage and conformity of the target volume.

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Session Classification: Session 24b - Brachytherapy

Track Classification: New Technologies in Radiation Oncology/Radiotherapy