Materials and Methods: 20 cervical cancer patients who underwent treatment at Royal Marsden Hospital were identified retrospectively. Both EBRT and BT plans were retrieved from radiotherapy archive. The plans were anonymised and transferred to VODCA-RT (MSS GmbH, Hagendorn, CH) which is a dosimetric analysis software. The rectum was recontoured using standardised anatomical definition of 2.5 cm from anal canal to the rectosigmoid junction. Posteriorly cut DSM were generated using VODCA-RT for both EBRT and BT. The raw data was then organised using in-house R script before being normalised to 21x21 pixels using MATLAB (Mathworks, Natick, MA). Assuming an α/β ratio of the linear quadratic model of 3Gy for the rectum, equivalent BED dose in 2Gy conversion was made using the equation shown below.

\[ DS M = \frac{n a x \times d e x \times (1+d e x) \times 0.6}{n a x \times d e x \times 1.6} \]

Dose values of corresponding pixels were then summed to derive the respective DSM. Maximum rectal toxicity such as bleeding and proctitis within 6 months of treatment were also recorded using CTCAE v4.0. Statistical analysis was performed using MedCalc software v14.10.2.

Results: Combined rectal DSM were successfully generated for all 20 patients using our methodology. An example of a combined DSM is illustrated in figure 1. As expected, there was significant variation between the mean rectal volume during EBRT and BT (67.71 cc and 53.99 cc respectively, p = 0.0189) due to presence of brachytherapy applicator and rectal retractor. There was also a mean difference of 0.59 cm between EBRT and BT rectal cranio-caudal length (p = 0.049). Normalisation to 21x21 pixels was therefore felt to be a good compromise to account for these anatomical differences whilst maintaining relatively accurate spatial dose distribution following dose summation. Consistent with previously published study by Buettner et al, ROC analysis on our data also demonstrated that lateral extent (rectal circumference) receiving >60Gy is a good predictor of risk of G1-3 proctitis (AUC = 0.879, p < 0.0001).

Conclusions: Rectal dose summation using DSM for cervical EBRT and BT is feasible. This method retains valuable spatial information which is closely correlated to toxicity. We propose a follow-up study with a bigger cohort incorporating organ motion for further validation of DSM as alternative assessment of rectal constraints in cervical cancer patients.

Reference:
OC-0276
Comparison of MRI, TRUS and CT for target definition in image-guided adaptive brachytherapy of cervical cancer
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Purpose/Objective: To compare the maximum target dimensions and image quality between magnetic resonance imaging (MRI), transrectal ultrasound (TRUS) and computed tomography (CT) in image guided adaptive brachytherapy (IGABT) of locally advanced cervical cancer.

Materials and Methods: All patients with locally advanced cervical cancer treated with radiochemotherapy and IGABT between 09/2012-05/2013 were included in this study. T2-weighted MRI (1.5 tesla), TRUS and CT were performed before (MRIpreBT, TRUSpreBT) and / or after (MRI BT, TRUSBT and CTBT) insertion of the applicator. 3D TRUS image acquisition was done with a customized US stepper device and software. The target was defined on 3D image sequences acquired with different imaging modalities by one blinded observer, in accordance to the GEC-ESTRO recommendations for MRI-based target volume delineation, as the complete cervical mass including the tumour, any suspicious areas of parametral invasion and the normal cervical stroma. Maximum target width and thickness were measured on transversal planes. Image quality was classified using the following scoring system: Grade 0: not depicted, Grade 1: inability to discriminate, margin not recognizable, Grade 2: fair discrimination, margin indistinct, Grade 3: excellent discrimination, margin distinct. Descriptive statistics, mean differences between the groups, with MRI BT as reference, and a paired t-test were calculated.

Results: Images from 21 patients (FIGO IB: 3, IIB: 11, IIBV: 5, IVB: 2) were available for analysis. The mean difference in maximum target width of TRUSBT, TRUSpreBT, MRIpreBT, CTBT to MRI BT was 0.5mm ±5.5 (n.s.), -1.7mm ±5.7 (n.s.), 0.0mm ±5.7 (n.s.) and 12.9mm ±6.1 (p < 0.001) (figure 1). The mean difference in maximum target thickness of TRUSBT, TRUSpreBT, MRIpreBT, CTBT to MRI BT was -3.5mm ±5.5 (p=0.012), -7.6mm ±5.5 (p=0.40), -7.6mm ±5.5 (p=0.62) and 11.8mm ±6.1 (p < 0.001). Mean scores of image quality of the target volume were 2.9 for TRUSpreBT, 2.3 for TRUSBT, 2.9 for MRIpreBT, 2.7 for MRI BT and 2.1 for CTBT.

Conclusions: TRUS seems to be superior to CT for assessment of the target volume in IGABT of cervical cancer as it yields systematically smaller deviations from the gold standard T2-weighted MRI, with reasonable image quality. Differences of TRUS target thickness might be related to differences in image slice orientation and compression of the target volume by the TRUS probe before insertion of the brachytherapy applicator.

OC-0277
Brachytherapy improves survival for inoperable stage I endometrial adenocarcinoma: a population-based analysis
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Purpose/Objective: To assess the use of brachytherapy with or without external beam radiation in medically inoperable stage I endometrial adenocarcinoma in the United States and to determine the effect of brachytherapy on overall survival (OS) and cause specific survival (CSS).

Materials and Methods: Data between 1998 and 2011 from the National Cancer Institute's Surveillance, Epidemiology and End Results (SEER) database were analyzed. Coarsened exact matching was used to adjust for differences in age, grade and year of diagnosis between patients who received brachytherapy and those who did not. Prognostic factors affecting OS and CSS including age, grade, race, marital status, metropolitan residential area, and year of diagnosis were evaluated using Kaplan Meier product-limit method and Cox proportional hazards regression model. Cumulative incidence was calculated using a competing risks model.

Results: A total of 460 patients with inoperable stage I endometrial adenocarcinoma treated with radiation therapy were identified. Radiation consisted of either external beam radiation (n=260) or brachytherapy with or without external beam radiation (n=200). The only factor associated with brachytherapy use was younger patient age (median age: 72 vs. 76, p=0.001). Median survival for all patients was 40 months. Patients who received brachytherapy had a higher 3 year OS (60% vs. 47%, p=0.001) and CSS (82% vs. 74%, p=0.032) compared to those who did not. On multivariate analysis, brachytherapy use was independently associated with an improved OS (OS: hazard ratio [HR]=0.68, 95% confidence interval [CI]: 0.52 - 0.87) and CSS (CSS: HR=0.61, 95% CI: 0.39 - 0.93). In the matched cohort of patients (n=260), the OS benefit associated with brachytherapy remained significant on multivariate analysis (OS: HR=0.65, 95% CI: 0.47 - 0.88). Brachytherapy was also associated with a lower 2 year cumulative incidence of cancer specific death (19% vs. 13%).

Conclusions: Brachytherapy is independently associated with an improved OS. It should be considered as part of the treatment regimen for all stage I inoperable endometrial patients undergoing radiation.

SP-0278
No bridge too far
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Presidential Symposium: