

Purpose: Conventional HDR (CHDR) brachytherapy for cervical cancers often fails to cover the entire gross tumor volume (GTV). CT/MRI-based 3-D planning allows optimization of dwell times for improved target coverage, but often at the cost of substantially higher doses to organs at risk (OARs). In the present study, we integrate image-guided HDR brachytherapy with concomitant complementary IMRT to boost target coverage and maintain low doses to OARs.

Method and Materials: Treatment planning CT and MRI images of 6 patients were acquired with CT/MRI-compatible carbon-fiber applicator. HDR plans were obtained by modifying CHDR plans to keep bladder and rectum dose below 80%. Based on these HDR plans, IMRT plans were subsequently optimized to complement the dose coverage of GTV with 3-mm margin (GTV⁺) and the uterus. To prevent anatomical deformation, IMRT plans were to be delivered immediately following image-guided HDR treatment with applicator in place. V_{95%} (Target volume receiving 95% prescription dose) and D₂ (minimum dose in 2.0-cm³ OAR volume receiving the highest dose) were used to compare IMRT-HDR technique with CHDR and HDR optimized for target coverage (OHDR).

Results: The MRT-HDR technique substantially improved target coverage while maintaining bladder and rectum doses at acceptable low level. For the six patients, V_{95%} for GTV⁺ and the uterus improved from the average of 56.8% and 51.4% in CHDR to 92.5% and 95.3% in IMRT-HDR, respectively. Average D₂ doses to bladder and rectum were 88.7% and 65.2% for CHDR and 72.4% and 71.4% for IMRT-HDR. In contrast, OHDR improved target coverage, but D₂ doses to bladder (>119%) and rectum (87.3% to > 200%) were unacceptably high.

Conclusion: Integrated complementary IMRT combined with image-guide HDR significantly improves dose coverage to the targets while maintaining low doses to OARs. It is dosimetrically and logistically feasible to clinically implement this technique for potentially improved outcome.