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Whole-pelvic radiotherapy with spot-scanning proton beams for uterine cervical cancer: a planning study

ABSTRACT

Whole-pelvic radiotherapy (WPRT) plays an important role in the treatment of uterine cervical cancer. The use of proton beams results in a modest reduction in the radiation dose delivered to normal tissues located in front of the target and a marked reduction in the dose delivered to normal tissues behind the target. The aim of this study was to compare the dosimetric parameters of whole-pelvic radiotherapy for cervical cancer among plans involving 3D conformal radiotherapy (3D-CRT), intensity-modulated radiotherapy (IMRT), or spot-scanning proton therapy (SSPT). The dose distributions of 3D-CRT-, IMRT-, and SSPT-based WPRT plans were compared in 10 patients with cervical cancer. All of the patients were treated with a prescribed dose of 50.4 Gy in 1.8-Gy daily fractions, and all of the plans involved the same planning target volume (PTV) constrictions. A 3D-CRT plan involving a four-field box, an IMRT plan involving seven coplanar fields, and an SSPT plan involving four fields were created. The median PTV D_{95%} did not differ between the 3D-CRT, IMRT and SSPT plans. The median conformity index 95% and homogeneity index of the IMRT and SSPT were better than those of the 3D-CRT. The homogeneity index of the SSPT was better than that of the IMRT. SSPT resulted in lower median V₂₀ values for the bladder wall, small intestine, colon, bilateral femoral heads, skin, and pelvic bone than IMRT. Comparing the D_{mean} values, SSPT spared the small intestine, colon, bilateral femoral heads, skin and pelvic bone to a greater extent than the other modalities. SSPT can reduce the irradiated volume of the organs at risk compared with 3D-CRT and IMRT, while maintaining excellent PTV coverage. Further investigations of SSPT are warranted to assess its role in the treatment of cervical cancer.