
Image-guided treatment planning in intra-cavitary HDR brachytherapy allows individualized optimization of the dose distribution. Dose-volume analysis offers possibilities for optimal dose distribution to meet the specific criteria for the dose prescription to the target volume and for limiting doses to surrounding normal tissues. This study presents a comparative analysis of the dose distribution to the target volume (high-risk clinical target volume [HR-CTV]) and normal structures obtained by 2 dose prescription methods: (1) the traditional method using the Manchester system with the dose prescription to Point A and (2) the GEC-ESTRO method with the dose prescription to 90% of the volume of the HR-CTV.

CT-MR-fused image sets of 16 patients with uterine cervix cancer were obtained for each of 5 fractions of HDR brachytherapy using tandem and ring applicators to generate 2 sets of treatment plans (for a total of 160 treatment plans) In the first set, the dose was prescribed to point A; in the second set, it was prescribed to HRCTV-D90. The per-fraction prescription dose (6 Gy) and the limiting doses to the bladder (4.6 Gy), rectum, and sigmoid (4.2Gy) were determined using EQD2 formulation (α/β of 10 Gy for the target and 3 Gy for organs at risk) accounting for the dose delivered by an external beam (total D90 for HR-CTV of 85 Gy, limiting EQD2 for bladder to 80 Gy, and that for rectum and sigmoid to 75 Gy).

While the dose prescription to point A may over-dose the HR-CTV-D90 by 10-40% for HR-CTV, with largest target radius <2cm, it may under-dose those by 5-25% for HR-CTV with the largest target radius >2cm. Dose received by the bladder, rectum and sigmoid depend on the volume of HR-CTV and the vicinity of the organ to HRCTV, while showing significant inter-fraction variation. Dose optimization with image guidance and the graphical method reduced the dose received by 2cc of the bladder (10-25%), rectum (10-20%), and sigmoid (10-35%). Mean ICRU bladder point doses and mean ICRU rectal point doses varied by 10-15% from the mean value of the maximum dose to 2cc of the bladder and rectum. Maximum dose to 2cc of the sigmoid was the most constraining parameter in 60% of the optimized plans.

Image-guided brachytherapy with dose-volume optimization offers a benefit by achieving the prescribed dose to HRCTV-D90 while restricting the doses to the bladder, rectum, and sigmoid close to their limiting values.