Editors' pick

Ring versus ovoid and intracavitary versus intracavitary-interstitial applicators in cervical cancer brachytherapy: results from the EMBRACE I study

Monica Serban, Christian Kirisits, Astrid de Leeuw, Richard Pötter, Ina Jürgenliemk-Schulz, Nicole Nesvacil, Jamema Swamidas, Robert Hudej, Gerry Lowe, Taran Paulsen Hellebust, Geetha Menon, Arun Oinam, Peter Bownes, Bernard Oosterveld, Marisol De Brabandere, Kees Koedooder, Anne Beate Langeland Marthinsen, Diane Whitney, Jacob Lindegaard, Kari Tanderup, EMBRACE Collaborative Group

Int. J. Radiation Oncol Biol Phys (2020), vol 106, pp 1052-1062

What was your motivation for initiating this study?

The tandem & ovoid (T&O) applicator is the most frequently used type of applicator in cervical cancer brachytherapy, followed by the tandem & ring (T&R). More recent designs for the intracavitary (IC) applicators involve the application of interstitial (IS) needles, guided into the paracervical regions and parametria, through the holes in the vaginal component of the applicator. The choice of applicator depends on how they fit at the exocervix and vaginal fornices as well as on institutional practice and physician experience and preference. Although the T&O and T&R have been considered clinically equivalent, significant dosimetric differences have been reported between the two applicators. Radiograph and CT-based dosimetric studies have shown that use of the T&O applicator leads to higher bladder and rectum doses, significantly longer treatment times with consequently increased prescription volumes (1.3–1.5 times higher) and consistently lower vaginal doses as compared to the T&R applicator. The shortcomings of these studies were limited tumour visualisation and small mono-centric patient cohorts.

One of the aims of the "International study on MRI-guided brachytherapy in locally advanced cervical cancer" (EMBRACE I, www.embracestudy.dk) was to establish reference material with regard to dose-volume histogram (DVH) parameters in cervical-cancer patients who were treated with MR-guided adaptive brachytherapy. Contouring and dose reporting were performed according to the guidelines of the Groupe Européen de Curiethérapie-European SocieTy for Radiotherapy and Oncology (GEC-ESTRO) Gyn working group. EMBRACE I was designed as an observational study, in which applicator choice and implant procedures were carried out according to the institutional practice, and therefore the study enabled comparison between radiotherapy techniques on a multi-institutional level. A total of 902 patients from 16 centres were eligible for this analysis.

What were the main challenges during the work?

There were a number of challenges that had to be overcome during this work, since EMBRACE I patients were not treated according to a specific treatment protocol and dose prescription was administered according to departmental practice. Moreover, in general, centres that treated routinely with the IC/IS technique had longer experience with the IC/IS technique. This was reflected in the percentage of IC/IS implants per patient, number of implanted needles and application of angulated needles. In our study we evaluated the differences between T&R and T&O, with/without needles, after controlling for multiple confounding factors that included those mentioned above.

What are the most important findings of your study?

With T&R-IC applicator and for small and intermediate high-risk clinical target volumes (CTVHR), it is possible to treat with smaller V85Gy (by 20 cm3) while maintaining at least as good a target dose as with T&O-IC applicator. At large target volumes, target coverage decreases drastically for both applicators. With T&R-IC applicator, bladder and rectum doses are significantly lower (by 5-7 Gy EQD23) while vagina 5 mm lateral point doses are significantly higher (by 20 Gy EQD23).

For both applicators, the addition of needles considerably increases target dose (e.g., by 5-9 Gy EQD210 at target volumes of 60 cm3), and decreases/maintains doses to organs at risk (OAR) and V85Gy. When combined with needles, the differences between applicators are decreased; however, the T&R remains favourable with regard to bladder and rectum doses.

What are the implications of this research?

Based on tumour topography as well as patient-related anatomical factors, an appropriate selection of brachytherapy technique and applicator type is very important to achieve the best possible target coverage and OAR sparing. This study has identified and explained potential causes of the differences that are seen in target volume and OAR doses with T&R versus T&O applicators. The results of this study support the need for departments to invest in advanced hybrid brachytherapy applicators.

For a more comprehensive view, besides the observed dosimetric differences, future research must further take into account the practical considerations and impact of technique, applicator and dose on disease and morbidity outcomes.

Monica Serban, PhD
Research fellow
Aarhus University
Aarhus, Denmark
&
Medical physicist
McGill University Health Centre
Montreal, Canada
monica.serban@mcgill.ca